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Visual Prioritization Process —USER'S MANUAL

U.S. Department of Transportation

Federal Highway Administration

prepared by

United States Department of Agriculture

Forest Service
7700-Engineering

Report No. FHWA-FLP-93-007

July 1994

FOREWORD

This study was funded as a part of the Coordinated Federal Lands Highway Technology Implementation Program. It is intended to serve the immediate needs of those who design and construct Federal Lands highways, but is also made available to all other interested parties.

This User's Manual is designed to describe and teach the Visual Prioritization Process (VPP). The VPP allows one to inventory and analyze the visual resources of a corridor and to assign priorities to the various segments of that corridor. The VPP can be used for project planning through each design step and is intended to be used by all design disciplines including engineers, landscape architects, and planners.

Thomas O. Edick

Thomas O. Edick—P.E.
Federal Lands Highway Program Administrator
Federal Highway Administration

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16. Abstract

Road construction and reconstruction projects are subjected to ever increasing scrutiny and criticism from aspects of environmental impacts and costs. Providing measures in road projects to mitigate environmental concerns including visual quality objectives, often threatens the economic viability of needed projects, especially in visually sensitive terrain.

On any given project, requirements for maintenance of visual quality may be imposed as a requirement for construction/reconstruction, and variations in "visual sensitivity" exist within areas with the same visual quality objectives. Blanket or uniform application of mitigation treatments within a given visual management category is not cost effective. The most sensitive areas should receive the full range of mitigation; less sensitive areas can receive less. The problem has been to identify and prioritize areas to receive different mitigation efforts, thus maximizing benefits to road users at the least cost.

The Visual Prioritization Process (VPP) was developed as a tool to analyze and inventory visual impacts and mitigation in connection with roadway improvement projects. This study refines the process to accomodate conditions relating to distances, angles, construction, and rankings within the models. The User's Manual is intended for use by all design disciplines including engineers, landscape architects and planners.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
	AREA			
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
	VOLUME			
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	l
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3

NOTE: Volumes greater than 1000 l shall be shown in m^3.

	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
	ILLUMINATION			
fc	foot-candles	10.76	lux	l
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
	FORCE and PRESSURE or STRESS			
lbf	poundforce	4.45	newtons	N
psi	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
	AREA			
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	ac
ha	hectares	2.47	acres	mi^2
km^2	square kilometers	0.386	square miles	
	VOLUME			
ml	milliliters	0.034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3

	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lb)	T
	TEMPERATURE (exact)			
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
	ILLUMINATION			
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
	FORCE and PRESSURE or STRESS			
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	psi

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

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Visual Prioritization Process
—User's Manual

Report No. FHWA-FLP-93-007

Results of Coordinated Federal Lands Highway Technology Implementation Program (CTIP) Study No. CTIP 90-F-11

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July 1994

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—VISUAL PRIORITIZATION PROCESS—

The Visual Prioritization Process (VPP) was first developed by Joanne Gallaher—who is both an employee of the Coronado National Forest, near Tucson, Arizona and a principal in the landscape architectural firm of Wheat-Gallaher in Tucson, Arizona—and by Sarah Davis of the Coronado National Forest. The process was developed and first applied in 1986 to the Mount Lemmon Highway improvement project, near Tucson, Arizona. As a result of the success of that project, the VPP received a National Endowment of the Arts Federal Design Achievement Award in November 1988.

After many requests for information on the VPP, a proposal was filed with the Coordinated Federal Lands Highway Technology Implementation Program (CTIP) to develop a manual of the Visual Prioritization Process. Funding was awarded in June 1990 through the Federal Highway Administration (FHWA).

A committee, chaired by Lola Mason, Civil Engineer, Forest Service, San Dimas Technology and Development Center, San Dimas, California, was formed to refine the VPP as well as to prepare the manual. That committee was comprised of Joanne Gallaher, representing the Coronado National Forest; Tom McGovern, a principal in the engineer- ing, planning, and surveying firm of McGovern, MacVittie, Lodge & Associates, Inc.; and Mark Taylor, Design Project Manager, Federal Highway Administration.

Also assisting were Bill Makel, Forester, San Dimas Technology and Development; Steve Galliano, Landscape Architect, Forest Service Southern Region; and Gary Johnson, Landscape Architect, National Park Service.

The VPP committee extends its appreciation to the peer review group for their comments on the draft. Thanks also to Rick Green for allowing the use of his Macintosh computer for the incorporation of the peer review comments.

—METRIC CONVERSIONS—

This report was originally prepared in English units. Although SI units are added in parenthesis in most cases, no attempt was made to convert English unit stationing on the drawings or where this appears in the text.

—DECISION MAKING PROCESS—

The VPP involves numerous decisions made at various times throughout the use of the process. These decisions should be based upon a sound decision-making system. This manual has been developed using the principles of Choosing By Advantages (CBA), explained further in Appendix D.

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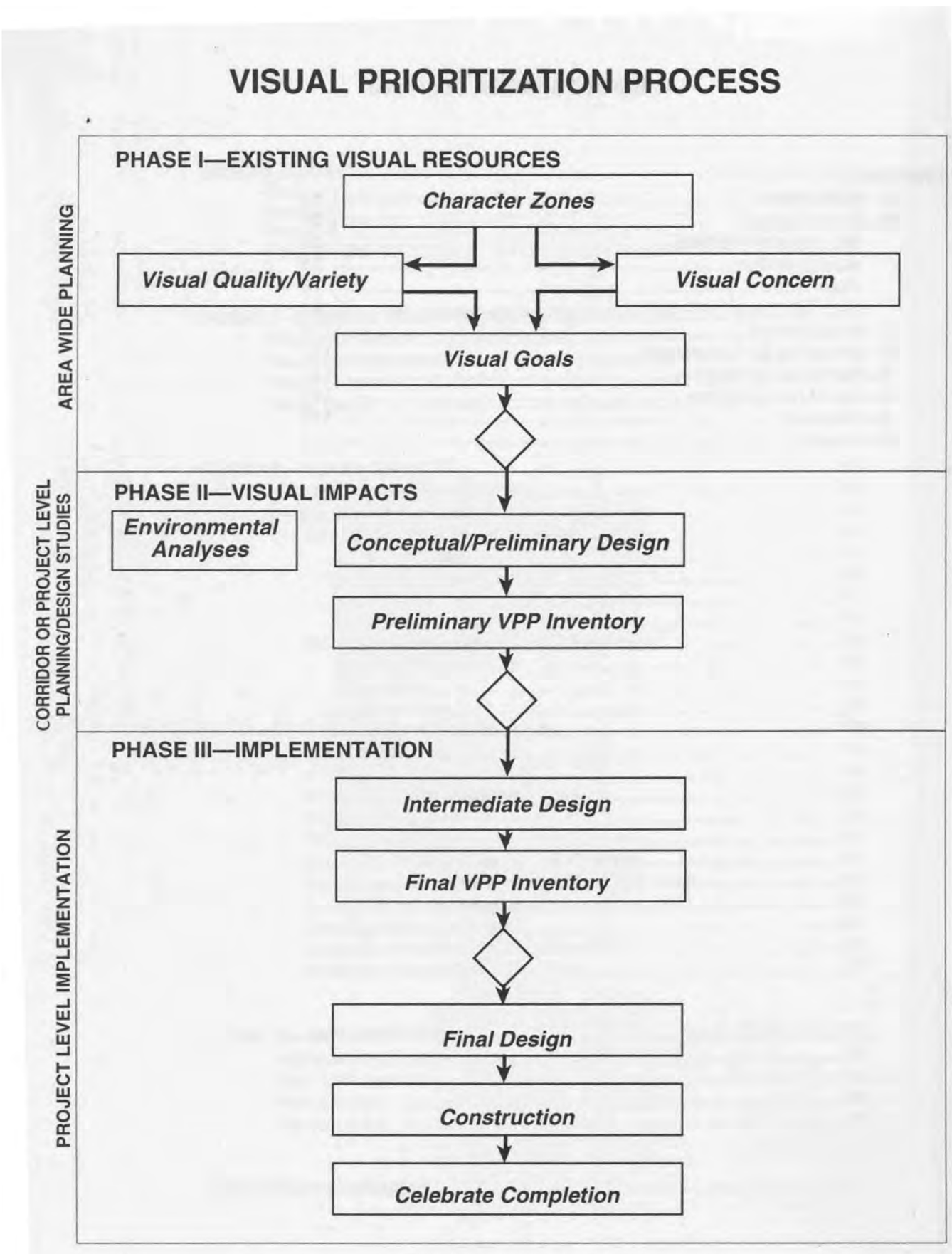


Figure 1. Flow chart of VPP.

INTRODUCTION

Most visual assessment processes are not developed specifically for scenic corridor projects. This leads to management of visual elements that is often general (vague) or evenly applied throughout the area being managed. In an era of limited financial resources, there is considerable need for acceptable methodologies to set priorities for resource allocation instead of universal applications. There is a need for a structured process to help a corridor blend in with its surroundings. This process should achieve visual goals in the least costly manner.

This *User's Manual* is designed to describe and teach a technique of visual resource analysis known as the Visual Prioritization Process (VPP) (figure 1). The VPP allows one to inventory and analyze the visual resources (both existing and proposed) of a corridor (figure 2). Priorities are then assigned to the various segments (units) of that corridor. VPP is intended to be used by and promote communication between all design disciplines—including engineers, landscape architects, and planners. The VPP can be used as a stand alone process, or, better yet, as a companion to other visual assessment and management processes.

VPP was first developed as a tool to inventory and analyze visual impacts and mitigation in connection with roadway improvement projects. It is also capable of being used for other linear projects—such as trails, waterways, and utilities. **The basic premise is that visual resources and visibility of visual elements along a corridor are not homogeneous, but vary, even in the most sensitive of areas. Consequently, mitigation can be varied in response to visual impacts while still meeting visual goals. VPP provides a method for analyzing the visual resources along a corridor and for assigning priorities for mitigation resources.**

Under this system, potential impacts are reviewed early in the process. VPP provides the framework to allow additional refinements at any point or stage in the process, making it linear or repetitive. It reduces duplication by building upon and refining established visual management methodologies. It is field oriented and recognizes that field work is necessary at the beginning and necessary for confirming conclusions at the end of the project.

Figure 2. Visual resources along corridor.

What sets VPP apart from other visual inventory systems is that it functions effectively at all levels of corridor and project planning and can be applied to the project level implementation stage. When used during the area-wide planning phase, the product of VPP is a definition of visual goals and determination of significant existing visual resources. When used during the corridor level design phase, the product of VPP is identification of significant visual resources, both existing and new, and the selection of an alternative

with the least visual impact. When used in the project level implementation phase, the end product is a map identifying Visual Priority Levels (VPL's) for each segment along the corridor, which guides the identification and mitigation of visual impacts.

This input can be incorporated into the engineering design to reduce the need for mitigation or in response to mitigation options. It assists the landscape architect in the design of mitigation measures and the prioritized distribution of limited mitigation resources. The detail of visual resource information gathered as part of the design phase can, and should, become an integral component of roadway design, resource analysis, natural resource mitigation, and/or urban design.

The extent of the VPP analysis can be tailored to the needs and budget of the project, in terms of personnel and resource costs. A streamlined application of VPP, which may address only the most significant visual elements, would require less design time than a complete application carried through all phases. The amount of time invested in VPP should be appropriate for each project.

The case studies show examples of different applications of VPP and varying design times. For example, the streamlined VPP analysis of the 3 mile (4.8 km) Mt. Lemmon Highway project involved approximately 160 hours of a landscape architect and 24 hours of review and input from an engineer. Phase I VPP was already in place on this project.

Natchez Trace, a more detailed application applied to a preliminary phase, involved 140 hours of time by the landscape architect conducting the inventory and 16 hours of review time by other landscape architects and engineers. This project was 1.1 miles (1.8 km) in length. On this project, Phase I needed to be completed. With training, the inventory, field work and quantity takeoffs can be performed by support staff—including upper management, designers, and technicians under the supervision of a landscape architect. The VPP can be easily understood and interpreted by project engineers, inspectors, contractors, and maintenance personnel.

Following is an overview of the Phases, figure 1, and examples shown in the case studies.

Phase I

Phase I, Existing Visual Resources, includes the activities of area-wide planning. A large scale visual assessment and management process is performed during this phase and the existing visual resources of the corridor area are inventoried. VPP remains compatible with other existing visual assessment and management processes, such as the Forest Service *Landscape Aesthetics Scenery Management System (SMS)* (reference 8) and the Bureau of Land Management (BLM) *Visual Resource Management Program* (reference 6). (See Appendix A, which provides a selected reference list, for these and all other documents cited in this manual.) Users of the VPP should become familiar with or have prior knowledge of a visual management process.

This inventory can be completed in conjunction with a specific project, or done in advance as part of land management planning. The Phase I inventory requirements can be completed using the process described here, or by utilizing another system (figure 3). Phase I includes four basic areas: description of the characteristic landscape, inventory of existing visual quality, assessment of people's concern for visual quality, and identification of visual goals.

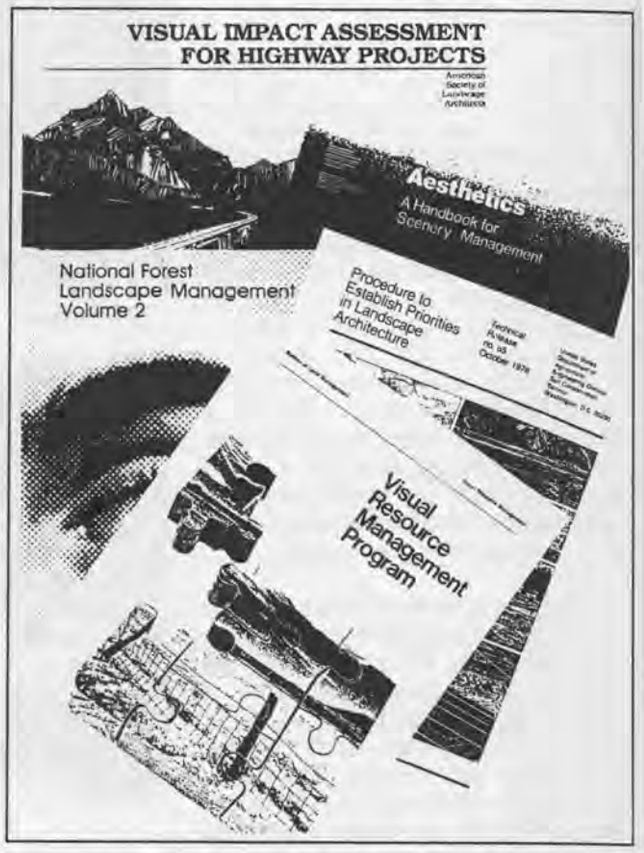


Figure 3. Various visual assessment and management processes.

The first step describes "character zones" relative to natural, cultural, and historic resources. This essentially is a qualitative description of those resources. Next, the "visual quality and variety" of the visual resources are evaluated. The uniqueness and richness of the visual elements are assessed. The "visual concern" assessment describes the expectation and desire of the user, observer, or constituent. Finally, "visual goals" are determined to establish the desired visual character and level of visual resource protection or enhancement.

At the conclusion of Phase I, a comprehensive visual resource management plan can be developed, or an existing plan can be revised, to reflect the results of the Phase I analysis. Visual goals or management classifications are established to define the degree of visual resource protection desired. From this plan, future capital improvement programs, or the immediate project at hand, can be evaluated. In either case, a proposed project can be evaluated for consistency with the visual resource management plan.

Phase II

Phase II, Visual Impacts, coincides with project level planning and design. This phase focuses on protecting and managing sensitive resources within a specific corridor or proposed project. The visual impacts phase of VPP allows designers (i.e., civil engineers, planners, and landscape architects) to (1) assess their design in regards to visual resource impacts, (2) modify the design, and (3) incorporate mitigation measures to lessen the impacts. By prioritizing areas along the corridor, a designer can allocate the budget proportionately for mitigation measures based on highest importance per dollar. At this stage, commitments from the environmental analysis will be incorporated into the plans or construction documents. Existing visual resources along the project corridor are inventoried in detail. Visual elements within the corridor and views from and to the corridor are identified. If appropriate, these elements and views can be grouped together with other adjacent similar elements and views into visual units. The various elements, views, and visual units can then be described relative to various distance zones.

Figure 4. Existing visual resource along corridor.

Next, "conceptual or preliminary design" features that impact visual resources within the corridor are identified. This work is performed with full knowledge of the existing visual resources identified and evaluated in the preceding steps (figure 4). As a part of this inventory, construction elements are identified that will be added as proposed (new) visual resources.

The final analysis of Phase II is called the "preliminary VPP inventory." A quantitative analysis of the impact the preliminary design has on the existing visual resource and on new visual elements is conducted. The analysis can be performed either on one or more alternatives or on individual construction elements (i.e., cut, fill, headwall, etc.), depending on the needs of the project and how the VPP is structured.

The impacts are ranked according to their relative significance, and "visual priority levels" are assigned. As a result, the preliminary design can be modified at

the earliest stage to lessen the impact, or the need for mitigation measures can be identified. Additionally, if alternative designs are available, the analysis allows the identification of the alternative with the least visual impact. Visual impacts and their mitigation must be balanced with other environmental and socioeconomic impacts for the selection of a preferred alternative.

Phase III

Phase III, Implementation, coincides with Project Level Implementation, and integrates the analysis into the final design and contract documents. Intermediate level construction plans are prepared in response to the preliminary VPP inventory. Next, a final VPP analysis, with emphasis on assigning and distributing mitigation measures and on evaluating mitigation costs, is completed. Mitigation measures are then incorporated into the final construction documents (figure 5). Finally, utilizing the results of VPP, actual construction impacts can be evaluated and adjustments made as needed during construction.

Case Studies

The VPP Committee (see Acknowledgments, third paragraph) commissioned four VPP case studies to document the process in actual use on real-world projects. The case studies show different applications of VPP, utilizing varying levels of personnel and other resources. These case studies show a streamlined version, as well as the full VPP, applied at different times during a project. The case studies provide an illustration of how VPP can be applied on different projects, at different levels, and in different land management situations.

The Mount Lemmon Highway case study is a roadway widening project. This project is on a scenic, mountainous road through the Coronado National Forest near Tucson, Arizona. This application of VPP only evaluated the visual impacts of new cuts and fills, which were the most significant visual impacts of the project. This case study reflects a partial application of the process and is considered a streamlined version. This approach is useful where visual impacts are focused and where the design budget limits the number of personnel and time committed to the visual analysis.

The second case study, the Navajo Bridge project, is located on a State Highway crossing the Colorado River, on National Park Service and Navajo Nation land in northern Arizona. This application of VPP considers all new and lost visual elements on the project, an example of the full application of VPP. However, the budget available for visual inventory precluded the final analysis of "Total Visual Change" and "Net Visual Change" on this project. Because of the relatively short length of the roadway, 0.8 miles (1.3 km), it was determined that this information was not required for the development of the mitigation plan.

The third case study is a roadway realignment and widening project for River Road, an urban road in Tucson, Arizona. This also represents a full application of the VPP, but without the final calculation of "Total Visual Change" and "Net Visual Change" due to budgetary and schedule limitations.

The Natchez Trace Parkway case study is a National Park Service project near Jackson, Mississippi. This case study shows a complete analysis of "Total" vs. "Net" visual change, useful in comparing alternatives or comparing impacts among several visual units in a corridor. This final evaluation was useful as a tool to evaluate alternatives during Preliminary Design.

The four case studies are contained in Appendix B of this manual.

Visual resource analysis is ideally initiated during planning stages and carried out through project level implementation. Three general phases, including area-wide planning, corridor planning and project design, and construction are outlined in this manual. VPP can be applied at each level. This User's Manual is intended to guide engineers, planners, landscape architects, and technicians in visual impact analysis and implementing appropriate mitigation. What follows is a description of a typical planning design and implementation process used by various land management agencies and design professionals, with examples of how VPP can be utilized in context with ongoing project activities. The flowcharts depict the basic relationships of the various phases and steps of the VPP. Relationships are more detailed in flowcharts under each Phase.

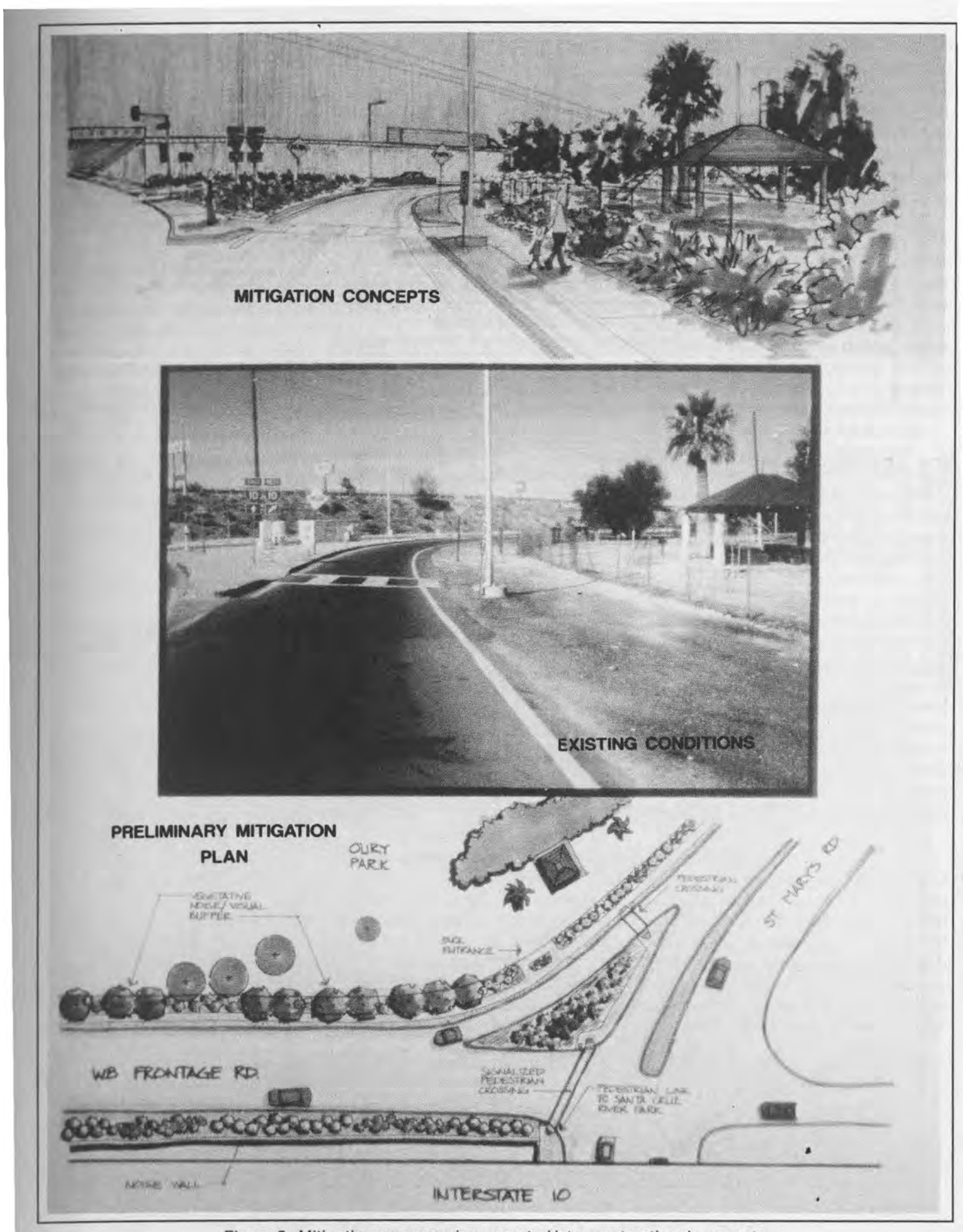


Figure 5. Mitigation measures incorporated into construction documents.

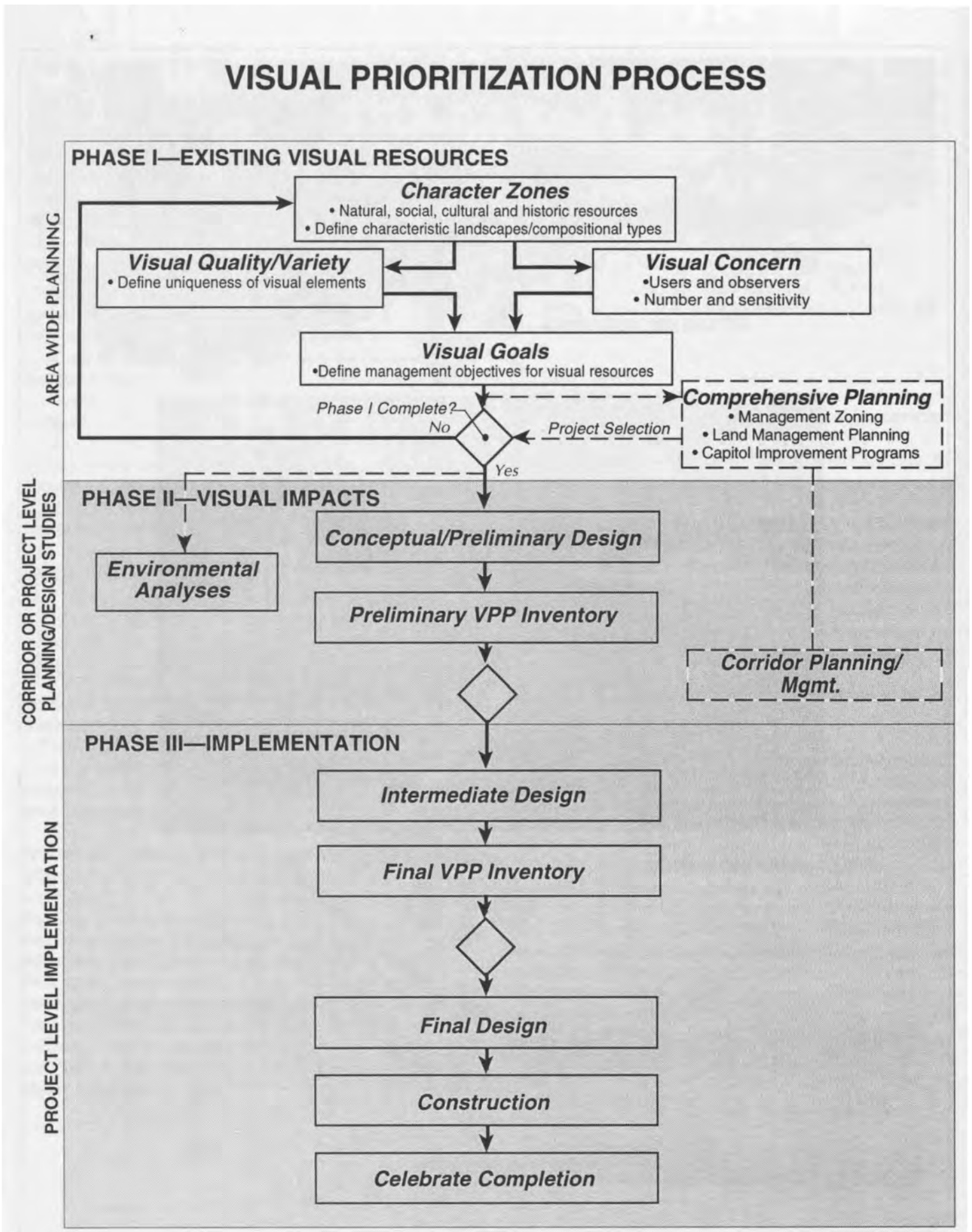


Figure 6. Detailed flow chart for Phase I.

PHASE I—EXISTING VISUAL RESOURCES

This portion of the VPP addresses the existing visual resources and character of an area (figure 6). The visual resources are studied and evaluated within the geographic area containing the particular corridor or proposed construction project. The project may lie within a national forest or a particular land management area and, if so, the study area may be defined by jurisdictional control. For visual analysis purposes, the study area should provide the context character zone within which to evaluate specific projects. This context should be determined by the landscape architect or planner, appropriate to the project.

Phase I of VPP coincides with the visual assessment and management process performed by many land management agencies. The various processes utilized are similar in that they measure existing visual resources and determine management goals. Users of the VPP need to become familiar with or have prior knowledge of a visual management process used to evaluate existing visual resources. One example is the Forest Service *"Landscape Aesthetics" SMS* process (reference 8). Among the other systems are the BLM's *Visual Resource Management (VRM)* (reference 6) and the *Procedure to Establish Priorities in Landscape Architecture*, Technical Release No. 65, Soil Conservation Service (SCS) (reference 5). Any of these inventory processes can be used or applied to VPP Phase I.

VPP Phase I includes four steps. The inventory includes a description of the unique character of the surrounding area, a description of the existing visual quality or attractiveness of the area, concern of the viewer for visual quality, and the goals or objectives for protecting and enhancing visual resources.

Phase I can be used apart from Phases II and III in connection with land management or view shed planning. In both activities, Phase I of VPP can provide the inventory and analysis of visual resources desirable for effective land use allocation and/or master planning. Phase I can also provide the preliminary framework for the further, more specific, project-oriented work of Phases II and III. Following is a description of VPP Phase I.

Character Zones

During the Character Zones assessment, the distinctive natural, social, cultural, and historic resources of the geographic area are described (figure 7). The natural landscape is typically defined by the major landforms within the planning/study area. This "nuance of place" is typically described in terms of the four fundamental visual components—form, line, color, and texture. (reference 3, Chapter 1).

The resources are described in qualitative terms. Depending on the size of the area and diversity of the visual components, the Character Zone may be subdivided into various visual units. The product of Phase I, Character Zones, is a description of the predominant features of the area that define visual quality. These features include landform, geology, topography, vegetation, drainages, land uses, historic resources and other elements that comprise the visual resources.

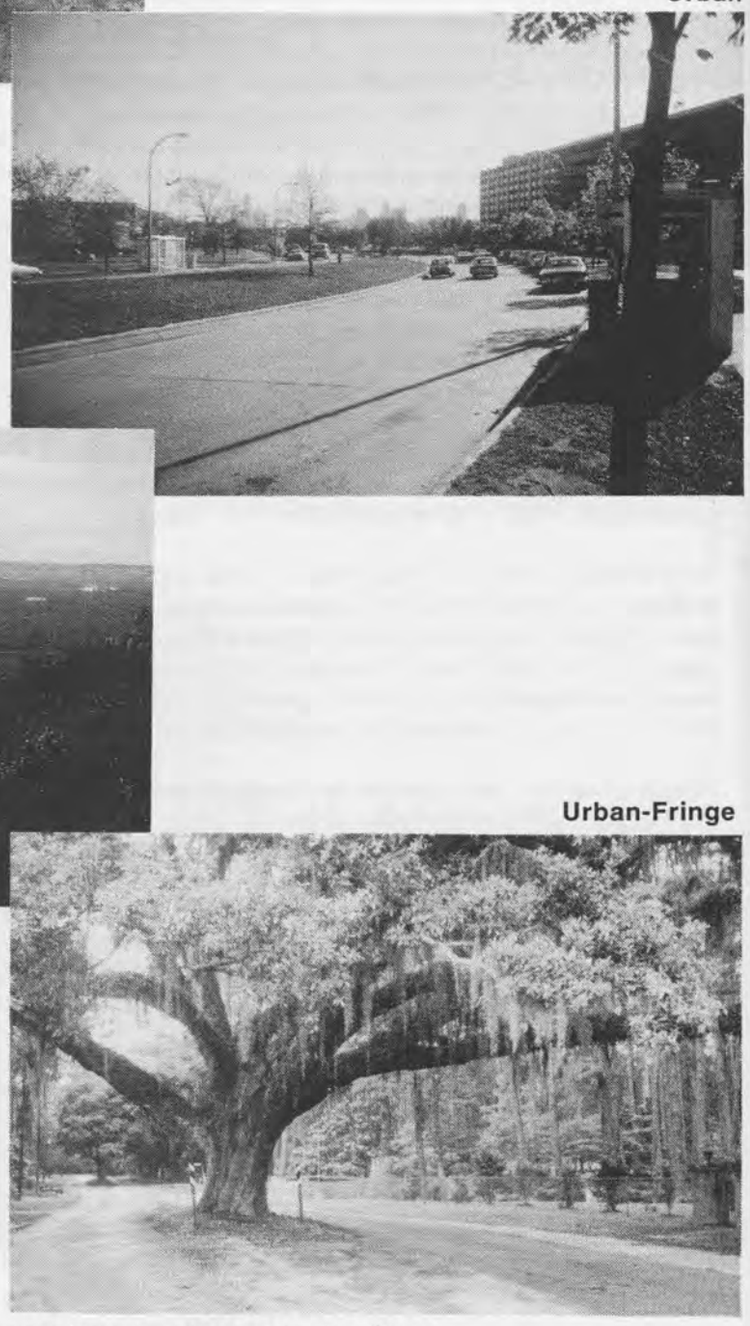
The case studies in Appendix B show examples of different character zones and how they are described. In the Mt. Lemmon case study, the description of the characteristic landscape addresses the landforms and the plant zones through which the roadway passes. The Navajo Bridge case study also describes the natural landscape of the project area, including the geological formations of the area and vast expanses of scenery. The River Road case study identifies four different character zones that relate to natural, cultural and visual resources. The character zone of the Natchez Trace Parkway project identifies forested enclosures and open meadows, with views of ponds, lakes, rural structures, and residences. The area is also characterized by gently rolling topography (see Appendix B). These descriptions of the surrounding landscape character add context to the VPP inventory.

Visual Quality/Variety

The Visual Quality/Variety assessment of Phase I defines the uniqueness and richness of the visual resources (figure 8). This definition can be expressed by the terms "distinctive" or "outstanding", "common" or "typical", and "minimal" or "below average". The "distinctive" landscape is considered the most attractive, with a richness in variety of visual elements. These areas would be the most significant. The "typical"

Mountainous

Urban



Rural

Urban-Fringe

Figure 7. Character zones, mountainous, urban, rural, urban-fringe.

landscape would contain visual elements normally found in the characteristic landscape. The "minimal" landscape is considered monotonous or uniform, and least significant. As previously indicated, many agencies, including the Forest Service (reference 3), and the BLM, (reference 6), utilize similar classification systems for describing visual quality. These systems can be used as a guide for inventorying visual quality for VPP. The definitions of visual quality will be unique to each character zone and each project. The designer will define these ratings according to the determined values.

Variety in vegetation and topography.

Monotonous vegetation and topography

Figure 8. Visual quality/variety of area, varied to monotonous.

The case studies, Appendix B, show examples of how visual quality was defined on four projects. In the Mt. Lemmon Highway case study, the Forest Service's Visual Management System was used, as the roadway is on national forest land. In the other case studies (Navajo Bridge, River Road, and Natchez Trace Parkway), the designer developed original definitions for "outstanding", "typical", and "below average/incongruous" visual quality. As in all inventory systems, the definitions of each variety class were described in terms unique to the project areas and character zones.

Visual Concern

The assessment of Visual Concern gauges the viewers' concern, expectations, and desires regarding the visual resource. The viewer may be a motorist using a roadway, a resident living near an urban project, a recreationist hiking through a national forest or park, or another constituent. Different viewers will likely have varying concern for visual quality.

The level of concern can be evaluated based on the number of viewers and the extent these viewers are concerned. This number can be expressed in terms of traffic volume or number of visitors to a destination, such as a national park. The concern of these viewers may be defined by what they have expressed or by conducting a user survey. Existing visual management systems include classifications for visual concern and constituent analysis.

Visual concern can be difficult to define. Identifying visual concern can be a subjective assessment based on apparent concern as evidenced by attention to visual quality, care, maintenance, and land use. It can be more objectively based on personal interviews or surveys. Visual concern should be integrated into the visual resource goals for the project rather than defining, or attempting to define, an individual landowner's concerns for visual quality, which may or may not be evident to the designer. Visual concern is ideally defined by direct contact with the users, landowners, and other constituents through an interview, survey, public meeting, or other public involvement process (figure 9).

Figure 9. Visual concern shown through public meetings.

The case study examples show how visual concern is defined on four projects. The Forest Service's "sensitivity"

Levels 1, 2 and 3 (Highest, Average, and Lowest Sensitivity, respectively) were utilized in the Mt. Lemmon Highway case study (reference1). The other case studies describe visual concern as "high", "average", and "below average", based on public involvement during the design process of each project (Appendix B).

Visual Goals

The fourth assessment in Phase I is Visual Goals, which should include a policy statement or specific objectives regarding visual resource preservation, conservation, and enhancement (figure 10). Other resources, such as natural, cultural and historic resources, may be addressed to the extent that they affect visual resources.

Figure 10. Visual goal, preservation of natural, social and recreational resources.

Many agencies have existing visual goals or objectives which are determined as part of their land management planning process. The Forest Service's "Landscape Aesthetics" SMS (reference 8) includes scenic condition objectives of: Preservation, Retention, Partial Retention, Modification, Marginally Acceptable , and Unacceptable.

The BLM (reference 6) has a similar system that defines management classes, which permit different degrees of alteration to the visual resources. Each agency can apply VPP to its own system to determine visual goals and objectives. On non-agency projects, visual goals can be described in terms of the desired relationship to the characteristic landscape and the desired visual condition.

The case study examples show both agency and non-agency descriptions of visual goals. The Mt. Lemmon Highway case study classifies the roadway corridor as having "retention" (within three years) as a Visual Quality Objective (Appendix B, page 34). The Navajo Bridge case study described the visual quality objectives equivalent to the BLM management Class 3. This management class is the close equivalent of the Forest Service's "Partial Retention" Scenic Condition or Visual Quality Objective. For Navajo Bridge, the significant visual elements were to be protected, and all new grading and revegetation were to blend with the surrounding characteristic landscape (Appendix B, page 59).

The River Road case study determined visual goals by first establishing that the roadway was designated as a scenic route by the local jurisdiction. The visual goals for the corridor included conservation and enhancement of the scenic resources (Appendix B, page 74). The Natchez Trace Parkway case study defines visual goals which included minimizing the visual impacts of the roadway elements of the Parkway, such as the graded shoulders (Appendix B, page 92).

Following Phase I, a comprehensive plan can be developed to address visual resources, possibly as part of a land management plan. In cases where a plan already exists, this inventory can be used to update or modify it. The plan may be policy-oriented, as with management zoning and land management planning; or program-oriented, such as capital improvement planning.

In the River Road case study, for example, a master plan entitled "Rillito Creek/River Road Design Process and Guidelines" (reference 9) was developed to guide future corridor development. This document, developed at the conclusion of Phase I, delineates the goals and objectives for management of the visual, natural, and aesthetic resources of River Road as it continues to develop and change.

The Phase I area-wide plan becomes an instrument to guide proposed projects. Once a project is proposed and focused to identify issues, the existing visual resource should be identified through Phase I of VPP. After this has been completed, the process moves to Phase II, which includes project design and identification of visual impacts.

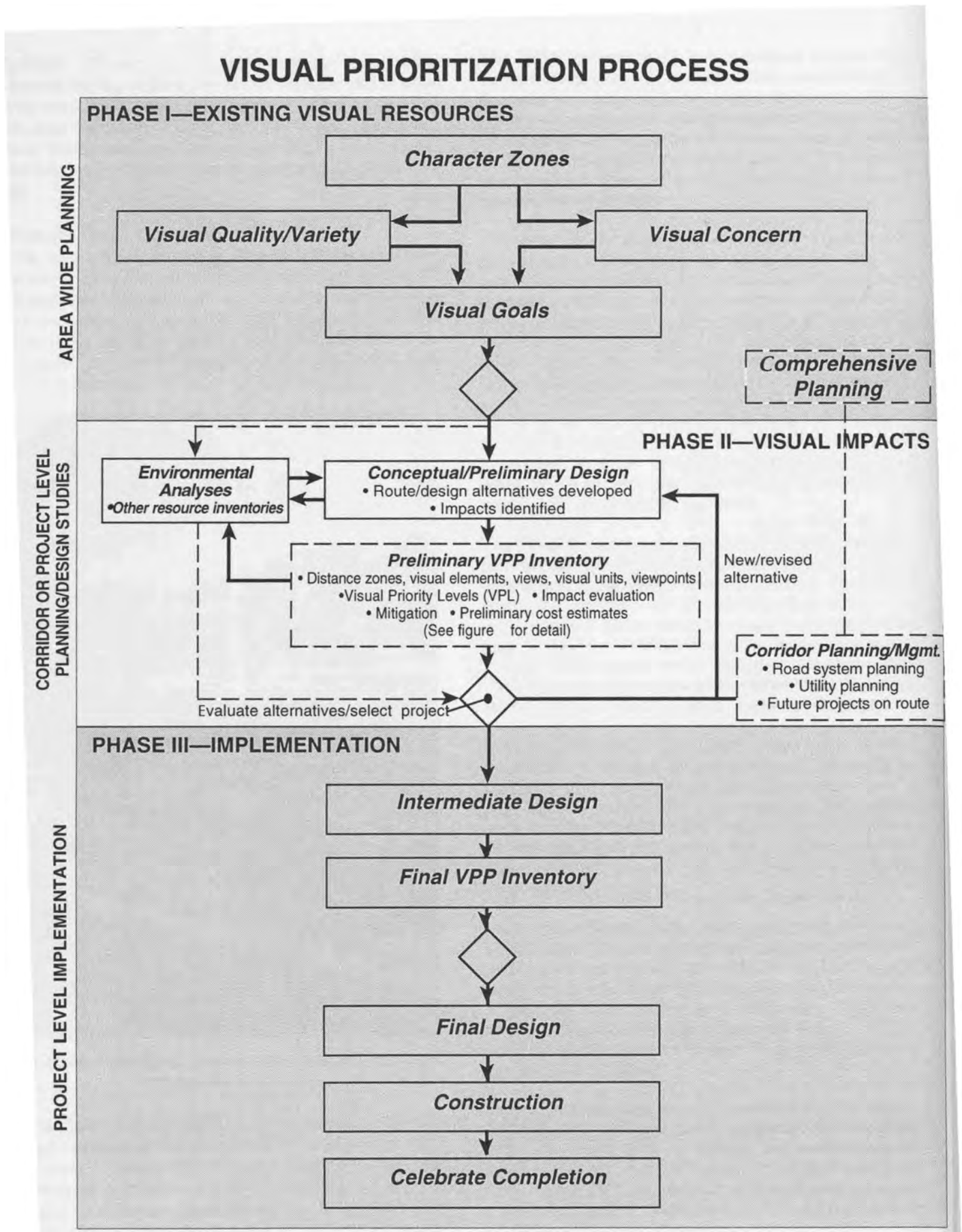


Figure 11. Flow chart, Phase II.

PHASE II—VISUAL IMPACTS

Phase II analysis is performed after Phase I is completed and the decision is made to proceed with the proposed project. While the focus of Phase I was the general area or region, the focus of Phase II is the specific project, corridor, or construction area (figure 11). While Phase I results in broad goals, Phase II results in a specific impact assessment.

Phase II begins with the development of a conceptual design, alternatives, or a preliminary design depending on the stage of corridor development. The design should take into account existing visual resources defined during Phase I and any new visual resources of the proposed project. The Preliminary VPP Inventory, (figure 12), is applied to evaluate the visual impacts of the preliminary design. These impacts are evaluated in how they conform to the visual goals.

Phase II proceeds within the context of area-wide planning provided by Phase I. Besides the visual resource assessment conducted in Phase I, if other studies have been conducted, the results would be reviewed and assimilated at this time. Such studies might relate to cultural resources, wildlife, water quality, or any number of other resources, and could take the form of Environmental Assessments, Environmental Impact Statements, etc. These resource analyses may not become available until a later time during Phase II. As can be seen on the VPP flow chart, (figure 11), these studies can be effectively assimilated at any time in Phase II for input into the design.

Conceptual/Preliminary Design

Phase II begins with the development of conceptual or preliminary plans, which should include roadway profiles and cross sections. At this time the engineer typically establishes and tests various routes, alignments, or design alternatives. Impacts on the visual goals of Phase I are considered while preliminary designs are being developed. Typically, project plans are less than 30 percent complete at this time.

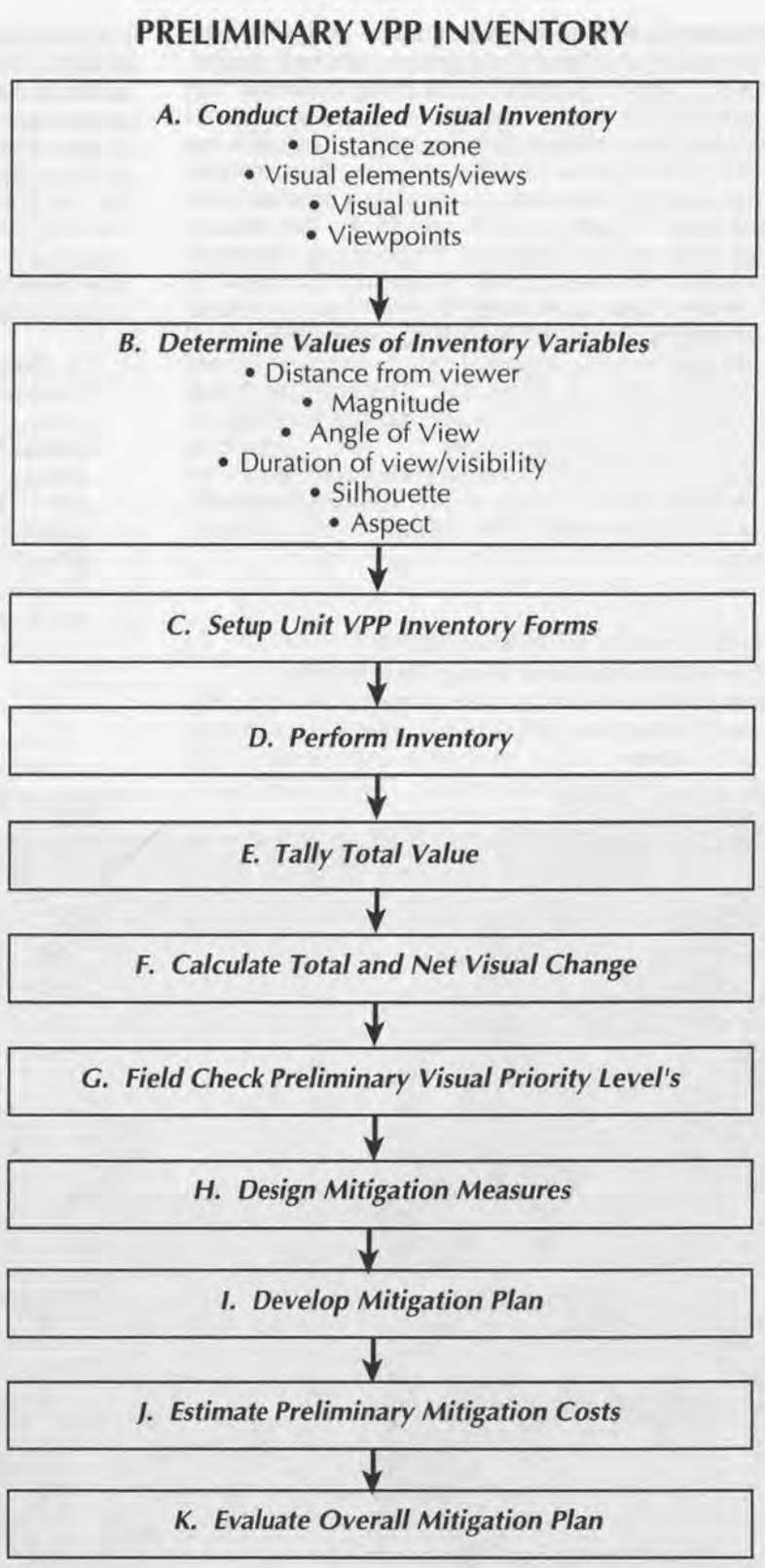

PRELIMINARY VPP INVENTORY
A. Conduct Detailed Visual Inventory
• Distance zone
• Visual elements/views
• Visual unit
• Viewpoints
B. Determine Values of Inventory Variables
• Distance from viewer
• Magnitude
• Angle of View
• Duration of view/visibility
• Silhouette
• Aspect
C. Setup Unit VPP Inventory Forms
D. Perform Inventory
E. Tally Total Value
F. Calculate Total and Net Visual Change
G. Field Check Preliminary Visual Priority Level's
H. Design Mitigation Measures
I. Develop Mitigation Plan
J. Estimate Preliminary Mitigation Costs
K. Evaluate Overall Mitigation Plan

Figure 12. Flow chart, preliminary VPP inventory.

The case studies show examples of how VPP was incorporated at different stages of roadway design. The Mt. Lemmon Highway case study indicates that the preliminary design incorporated more total cut and selectively located fills in order to mitigate the visual impacts of side-cast fill conditions. For example, a large quantity of excess material was concentrated in one area to form a scenic overlook. The Navajo Bridge case study shows how the roadway alignment can respond to visual goals (Appendix B, page 71). The River Road case study shows how the overall goals and objectives of its "Design Process and Guidelines" helped to direct the alignment study and preliminary design (Appendix B, page 74). The Natchez Trace case study showed how design alternatives can be analyzed, (Appendix B, pages 105-106). Typically, the earlier the visual inventory information can be available for consideration, the more likely the results can be incorporated. This results in an improved project.

Preliminmary VPP Inventory

A. Conduct Detailed Visual Inventory

A detailed visual inventory is conducted at the beginning of the Preliminary VPP. This inventory includes distance zones, visual elements and views, visual units, and viewpoints (figure 12). The detailed visual inventory is similar to the Character Zones of Phase I in that it is intended to describe the character of the landscape, except that the focus here is on the immediate project area and the proposed changes. This description is based on the vantage points of an observer in or moving through the corridor, as well as from one outside the corridor looking at or through the corridor. However, to respond to different conditions, the detailed visual inventories will be unique to each project. The four case studies demonstrate this level of inventory on four projects.

1. Distance Zones

Distance zones are defined according to the character zone and design speed of the project. VPP utilizes four distance zones—immediate foreground, foreground, middle ground and background (figure 13). The distance zones should reflect the characteristic landscape and are unique to each project. They should also consider the management objectives, atmospheric influences, landscape scale, and visual acuity. Following is a general range for distance zones (reference 8):

Immediate foreground..... 0 to 300 ft (0 to 91.4 m)
Foreground ..... 300 ft to 1/2 mi (91.4 m to 0.8 km)
Middle ground.... 1/2 mi to 4 mi (0.8 km to 6.4 km)
Background ..... 4+ mi (6.4+ km)

Figure 13. Distance zones include urban development and vegetation in the immediate foreground and foreground, with mountains in the background. The middleground distance zone is not visible from this viewpoint.

The Federal Highway Administration report *Visual Impact Assessment For Highway Projects* (reference 2), is used for defining various distance zones. Appendix B of the FHWA report (reference 2) contains a table with focusing distance, angle of vision, and peripheral angle for some design speeds (reprinted here) (figure 14).

Design Speed	Focusing Distance	Angle of Vision	Peripheral Angle
30 mph (48.3 km/h)	800 ft (243.8 m)		
40 mph (64.4 km/h)	1,110 ft (338.3 m)	37°	60°
50 mph (80.5 km/h)	1,400 ft (426.7 m)	29°	55°
60 mph (96.6 km/h)	1,800 ft (548.6 m)	20°	45°

Figure 14. Distance Zones (FHWA).

Following is an example of a project-specific version of the Angle of Vision Diagram, utilizing information from the FHWA publication (reference 2)(figure 15).

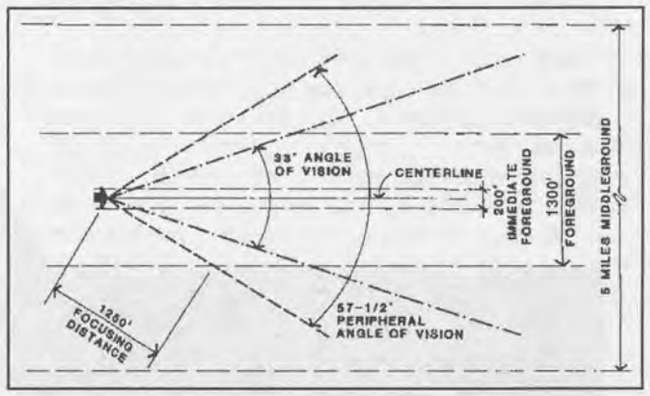


Figure 15. Angle of vision diagram for 45 mph (72.5 km/h) design speed.

2. Visual Elements/Views

Significant existing and new visual elements (figure 16), which are proposed in the preliminary design, are identified for the VPP analysis by the landscape

Figure 16. Historic wall, significant positive visual element.

Figure 17. This rockfall containment structure is an existing, negative visual element along this roadway.

architect or designer. These elements should be limited to those that are significant in terms of visual context (figure 17). Examples of visual elements are cuts, fills, new background views, new foreground views, retaining walls, vegetation, etc. An element that is significant in one character zone is not necessarily significant in another. The scope of the VPP inventory is partially determined by the number of elements addressed in the process. If the visual inventory budget is limited, the VPP inventory can be limited by selecting only the most significant visual elements on the project.

After the significant visual elements have been identified for the project, they are classified by the following four categories:

- *New visual elements which are neutral or positive in context with the character zone.* These elements should contribute to, support, or not effect the character zone.

- *New visual elements which are negative in context with the character zone.* These are elements which detract from the character zone.

- *Existing positive and neutral visual elements that are lost.* These are elements which contribute to, support, or do not effect the character zone, and which will be removed as a result of the project.

- *Existing negative visual elements that are lost.* These elements detract from the character zone, and will be removed as part of the proposed project.

The case studies provide examples of different visual elements studied on the different projects. The Mt. Lemmon Highway environmental study of the 25 mile (40.3 km) corridor found that the lower 4 miles (6.4 km) warranted special attention, because "long stretches are visible in the background from Tucson" (see Appendix B, figure B-2). *Cuts and fills* were identified as the most significant new visual elements . The Natchez Trace Parkway case study inventory identified *forested areas, an old tree-canopied roadway, and adjacent developments*—(Appendix B, figure B-55)—as key visual elements along the corridor.

3. Visual Units

Visual units should generally be developed as components of a landscape character type, smaller in size than the entire view shed. Topographic, vegetative, land use/development, and view components could all combine to define landscape units (figure 18). On national forest land, it is recom-mended that landscape units be developed in conjunction with the SMS guidelines (reference 8). On other public lands, and in urban or mixed-use areas, guidelines can be developed and tailored to meet the needs of the project.

The Navajo Bridge case study defined eight visual units, with existing visual resources within each unit being classified as "outstanding", "average", and "below average" (Appendix B, figure B-28). The River Road case study found both foreground and background views to be important. Fourteen visual units were identified, with visual quality and visual concern defined within each unit (Appendix B, figure B-41).

4. Viewpoints

The next task is to identify the significant viewing areas along and adjacent to the corridor which should be included in the inventory ratings. The selection of these areas is based on both the constituents' visual concern and visibility of the proposed project. The number and location of viewpoints are determined for each project.

The number of viewpoints selected for the VPP inventory effects the scope of the study, and the amount of staff time and resources required. If the visual inventory budget is limited, the VPP can be streamlined to include only the most significant viewpoints for the analysis. Where multiple viewpoints are possible, such as in a subdivision adjacent to a roadway corridor, one or more representative viewpoints can be identified for the analysis. The Natchez Trace case study provides an example of this situation (Appendix B, figure B-62). Also, assumptions can be made by the designer that only the most sensitive ranking will be used if a visual element is visible within multiple distance zones from a single viewpoint. Such assumptions should be clarified early in the VPP process, and followed closely throughout the inventory, to remain consistent. An example of this type of an assumption is in the Navajo Bridge Case study (Appendix B, figure B-31), under Duration of View/Visibility.

Figure 18. Aerial photographs are useful in determining visual units, based on topography, vegetation, geology, land use, etc.

Figure 19. The retaining wall in the middleground distance zone is visible from this viewpoint, a scenic overlook.

B. Determine Values of Inventory Variables

After the detailed visual inventory is complete, the values are determined for the VPP inventory variables for each numerical score. The inventory variables and numerical scores are constant in all VPP analyses, but the values need to be determined for each project to be in context with the character zone and constituents' concerns. **This step determines the validity of the VPP analysis and requires careful consideration of the landscape architect or planner in charge of the VPP.**

Following is a description of the VPP inventory variables:

1. Distance From Viewer

The *distance from viewer* variable is based on the distance zones defined during the detailed visual inventory. It is the distance between the viewer and the elements, based on selected view-points, speed, and angle of vision.

2. Magnitude

The second variable is *magnitude,* (reference 8 page 17). This describes the scale (size) of the element and needs to be defined for each element identified in the inventory. The ranges assigned for the magnitude ratings are determined for each project according to the character zone and should be field checked for relative importance.

3. Angle of View

Another variable is *angle of view*, which can be defined horizontally and/or vertically from the observer. The angle is measured between the viewer's direct, straight forward line of sight and line of sight to the element. This measurement differs from the Angle of Vision, used previously to define the distance zones. The angle of view measures three zones of visual clarity: the inner zone, where details are sharp and clear, and two peripheral vision zones, where the viewer is aware of objects but can't focus on all details. The ranges for these ratings are based on the design speed and the visibility from selected viewpoints.

4. Duration of View/ Visibility

The fourth variable is *duration of view or visibility* and is simply how long a visual element is visible within a given distance zone. These are based on

the design speed for scoring of views while moving through the corridor and on ratings assigned by the designer for other viewpoints along the corridor. Visibility could be measured in terms of viewing time when driving by, visibility from one or more stationary locations (such as pullouts, vista overlooks, adjacent properties, etc.), or a combination of these factors.

5. Silhouette

Silhouette, or the outline of the visual element against the background, is an optional VPP inventory variable. This condition may or may not be a factor to include in the VPP, depending on the character zone and project. Different values can be assigned according to varying degrees of contrast in the silhouette. For example, a silhouette against the sky will typically result in a stronger visual contrast than against vegetation.

6. Aspect

Aspect is a variable that deals with orientation and verticality of the visual element to the viewer. Ratings are assigned which depend on the degree to which the element is vertical and facing the point of observation (with higher visibility), or the degree to which it is horizontal and facing away from the point of observation (with lower visibility).

The values of the variables are defined by the designer as dictated by the conditions of the project. It is imperative for sound decision making (e.g., CBA, Appendix D or Performance Indexing, Appendix E) **that values with equivalent numerical scores have equivalent relative importance, and that equivalent increases in numerical scores mean equivalent increases in relative importance between the sets of values.**

With reference to tabular data contained in figure 20, the *magnitude* value of 4,000+ sq ft (372 sq m), a numerical score of 3, should be as relatively important as an *angle of view* value of 0 to 15 degrees (again, a 3). The increment between a value with a numerical score of 1 and a value with a numerical score of 2 should have the same change in relative importance as the increment between a value with a numerical score of 2 and a value with a numerical score of 3. Each of the values should also be field checked for context for appropriateness within the character zone.

The method of assignment of values for inventory variables is demonstrated by the values from the Mt. Lemmon Highway case study (figure 20):

Inventory variables	Numerical score
1. Distance from the viewer:	N/A
Immediate Foreground: up to 300 ft (91.4 m)	
Foreground: 300 ft to 660 ft (91.4 m to 201.2 m) (0.0381m) (1/8 mi)	
Middle ground: 1/8 mi to 3 mi (201.2 m to 4.8 km)	
Background: 3+ mi (4.8+ km)	
2. Magnitude:	
600 sq ft (0 to 55.7 sq m)	1
600 to 4000 sq ft (55.7 sq m to 371.6 sq m)	2
4000+ sq ft (371.6+ sq m)	3
3. Angle of the view (horizontal):	
46 to 90 degrees	1
16 to 45 degrees	2
0 to 15 degrees	3
4. Duration of the view:	
0 to 7 sec—up to 300 ft (91.4 m)	1
7 to 12 sec—300 to 500 ft (91.4 m to 152.4 m)	2
12+ sec—500+ ft (152.4+ m)	3
5. Silhouette condition:	
No silhouette	0
Background is vegetation	1
Background is sky	2
6. Aspect:	
Angles flat, to away from, viewer	1
Angles 45 degrees to flat	2
Angles vertical to 45 degrees	3

Figure 20. Values for inventory variables.

A numerical score, indicated on the right, is assigned for each variable per visual element evaluated. For this case study, the score is either 1, 2 or 3—with 1 representing the least visually evident, and 3 indicating the most visually evident. Each project has its own unique values for each variable. The range of each value varies and is based on the relative importance of the value compared to the other values. The other case studies provide examples of values for numerical scores assigned to visual elements in the different character zones.

C. *Set up Unit VPP Inventory Forms*

The Preliminary VPP Inventory continues by setting up the unit VPP inventory forms. On these forms, visual elements/views which were identified in the detailed visual inventory as "positive", "negative", or "neutral" (in the context of the character zone) are listed by the four categories previously determined:

- *New visual elements which are neutral or positive in context with the character zone.*

- *New visual elements which are negative in context with the character zone.*

- *Existing positive and neutral visual elements that are lost.*

- *Existing negative visual elements that are lost.*

The four categories should be distinguished on the inventory form. Separate forms are used for each category so that all four categories of visual elements are covered. Refer to Appendix B, figure B-32 & B-33 for example forms with the elements classified by appropriate category. This information can also be tabulated on a computer spreadsheet.

D. Perform Inventory

The next step is to conduct the actual inventory. Thus far, values for all the variables have been determined for each of their three numerical scores. Also, all the visual elements, for each viewpoint of the element, has been listed on a VPP inventory form. Now, a numerical score is entered for each variable in the proper distance zone of each element.

The inventory is based on the staked roadway alignment and preliminary design plans, profiles, and cross sections previously developed in this phase. The inventory involves initial field work, analysis in the office, and checking the variables again in the field. Once the elements and quantification of the variables (values) have been defined and field checked for appropriateness and validity, it is possible that the numerical scores of the variables can be assigned in the office by a drafter or technician. Much of the scoring is based on the elements' size, position and orientation to the selected viewpoints, which is fairly straight forward. So, information can be derived from the plans to determine the value for each view of an element. It is important that each of these values be checked in the field and revised as needed. Consistency in assigning scores is very important to the validity of the VPP. If more than one person assigns scores,

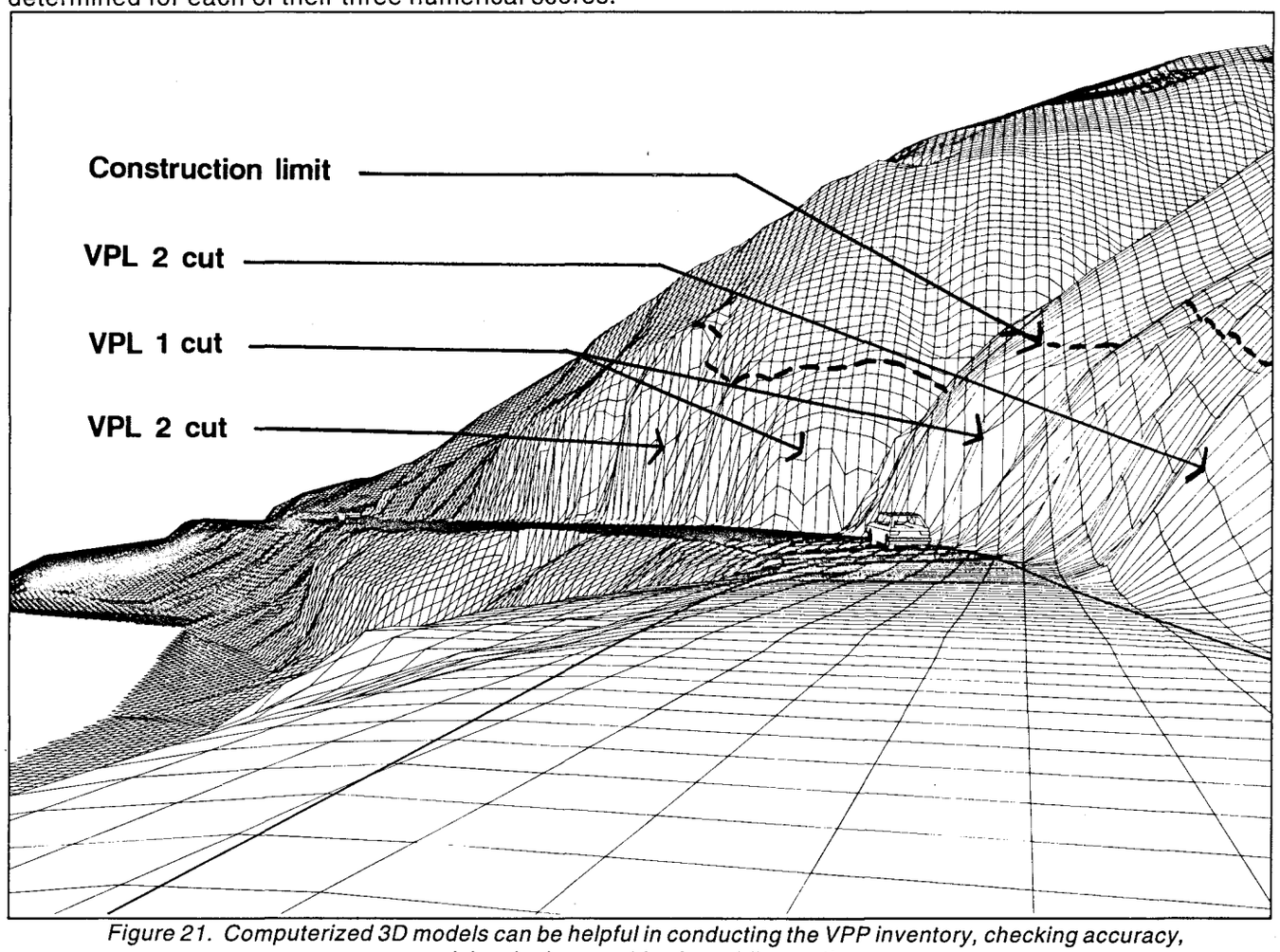


Figure 21. Computerized 3D models can be helpful in conducting the VPP inventory, checking accuracy, and developing graphics for public meetings.

the application of assumptions and scoring technique should be compared for consistency. Computer imaging, if available, can be extremely useful during this process, to project a 3-D image of a proposed roadway or visual element (figure 21). This image can assist the designer in assigning an accurate score. The Natchez Trace case study contains examples of computer-enhanced photos to depict a proposed bridge (Appendix B, B-67, B-72). If these resources are not available, the designer must rely on field work and 2-D information on the plans.

E. Tally Total Values

The numerical scores on the VPP inventory form are then tallied for a subtotal of each *new* and *lost* visual resource, both positive and negative. The subtotal is *always* a positive value. The subtotal of each visual element in all units is used to rate and determine visual priority levels (VPL) for each element. These are determined by rating the subtotals of each element from the highest number to the lowest number and dividing the list into *high* - VPL 1, *medium* - VPL 2, and *low* - VPL 3. This information is entered on the VPL form. The divisions should be based on the context within the character zone (Appendix B, figure 36) determined by the designer in charge of the VPP.

F. Calculate Total and Net Visual Change

The total of each unit can be used in the distribution of mitigation measures. The unit totals (the sum of all elements for each visual unit) are entered on the Unit Totals form and should include subtotals for the four categories of visual elements:

a. *New visual elements which are neutral or positive in context with the character zone.*

b. *New visual elements which are negative in context with the character zone.*

c. *Existing positive and neutral visual elements that are lost.*

d. *Existing negative visual elements that are lost.*

For each visual unit, calculate the following:

Total Visual Change (TVC) = $a + b + c + d$
Net Visual Change (NVC) = $b + d - a - c$

Total visual change (TVC) is significant on a project where both positive and negative elements are being introduced. Constituents are generally sensitive to any kind of change to visual resources and views, both positive and negative. It is helpful for a designer to recognize where the largest changes are occurring on a project, rather than focusing only on the mitigation of negative impacts. Net Visual Change (NVC) indicates where negative impacts are highest.

The calculation of TVC and NVC is optional and is, perhaps, most useful in the comparison of alternatives or on a complex project where unit comparisons are desired.

An example of TVC and NVC is shown in the Natchez Trace case study (Appendix B, p. 106). This rating shows where the visual impacts, both positive and negative, are the highest (TVC) and where the negative visual impacts are the highest (NVC).

G. Field Check Preliminary Visual Priority Levels

At this time, the preliminary VPL's should be field checked and verified. Ideally, the field check should be with an interdisciplinary team to make sure the Visual Priority Levels are appropriate for the project. If the inventory variables need to be revised or refined, this is the time to do so. Once the VPL's are accepted, calculations of (TVC) and (NVC) can be finalized.

All units are then compared for TVC and NVC. This information shows the units with the greatest amount of change, which could establish priorities for mitigation. This information is also beneficial for choosing between alternatives, typically emphasizing the alternative with the least amount of change, or lowest in negative change.

H. Design Mitigation Measures

A mitigation strategy should be developed to determine the range of mitigation measures for the project to meet the visual goals, as well as other environment and design goals of the project. Each proposed new visual element will need design input or mitigation appropriate to the character zone. A mitigation plan will also be needed to minimize any degradation to the character zone due to lost significant visual resources.

During this stage, the commitments made during the environmental studies would be interpreted into a design approach for incorporation into the project plans.

I. Develop Mitigation Plan

As part of the mitigation plan, the mitigation measures are distributed throughout the project according to combinations of some or all of the following factors:

1. Units where TVC and NVC are highest

2. Units where significant positive and neutral visual elements that are lost are highest

3. Units where detrimental new visual elements are highest

4. Units where highest visibility occurs (highest VPL's per negative element), where opportunities for enhancing positive visual elements and views remain, and where increasing visual quality and variety are greatest

5. Units where visual concern is highest

6. Each element or unit's importance/cost with the total unit value being the importance. The higher the importance/cost, the wiser the use of funds.

Design and distribution of the mitigation measures constitutes the mitigation plan. The plan should be based on the uniqueness of the "character zone", as well as meeting other environmental needs of the project.

Specific measures can be designed and utilized to mitigate or reduce each of the negative effects. Examples are revegetation, special blasting techniques to achieve variety in rock cuts, drainage solutions that do not visually dominate the natural terrain, or variety in the roadside grading to add variety and a natural appearance to otherwise uniform fill slopes. During this stage, the mitigation concepts would be developed into actual design details and integrated into the construction documents.

In reference to the Mitigation Plan factors referenced above, the Mt. Lemmon Highway case study is an example where only one factor was used in the mitigation plan (Factor No.4).

The VPP inventory identified all cuts and fills and recorded each on an inventory sheet with corresponding values and scores. This formed the basis for the *visual priority levels* on which the distribution of mitigation resources were based.

The Navajo Bridge case study is an example of where a combination of factors (Nos. 2, 3, and 4) was used. It quantified both new visual elements and loss of significant visual resources. The new visual elements included cuts, fills, headwalls and endwalls, guardrail, and views of several objects. The loss of significant visual elements included native vegetation, open view, view of existing Navajo commercial area, view of natural drainage, enclosed view, and view of historic structure at interpretive area. The person in charge of the VPP analysis must determine the appropriate factors in developing a mitigation plan unique to each project.

J. Estimate Preliminary Mitigation Costs

Once the mitigation measures have been designed and distributed for the entire project, a preliminary mitigation cost estimate is prepared. The advantage of the VPP is that it distributes mitigation measures where they will have the largest impact. For example, the mitigation costs in the Mt. Lemmon Highway Case study ranged from $0.91/sq ft ($9.80/sq m) for cut areas in VPL 1, to $0.48/sq ft ($5.71/sq m) for cut areas in VPL 3 (Appendix B, p. 49). Each project should reflect a mitigation cost range among the VPL's.

K. Evaluate Overall Mitigation Plan

To evaluate the overall mitigation plan, the preliminary cost estimate must be compared to the budget or available mitigation resources. If a large discrepancy between the two exists, the team can review the key areas of the preliminary design and VPP inventory, looking for areas where the facility design, the mitigation design, or the budget might be adjusted.

At the conclusion of Phase II, the preliminary design or design alternatives have been evaluated in terms of their responsiveness to the visual goals of Phase I as well as other resource goals. If the mitigation can be designed to be effective and practical, or if a preferred alternative can be chosen, then the evaluation moves to Phase III of the process. If the design is deemed inappropriate, in that the impacts are excessive and/or the mitigation is ineffective or uneconomic, then the process goes back either to preliminary design or to the Corridor Planning/Management stage for further planning and programming activities. Likewise, if the design is acceptable but no funding exists, the project may be "held" in Corridor Planning/Management until implementation (Phase III) is authorized.

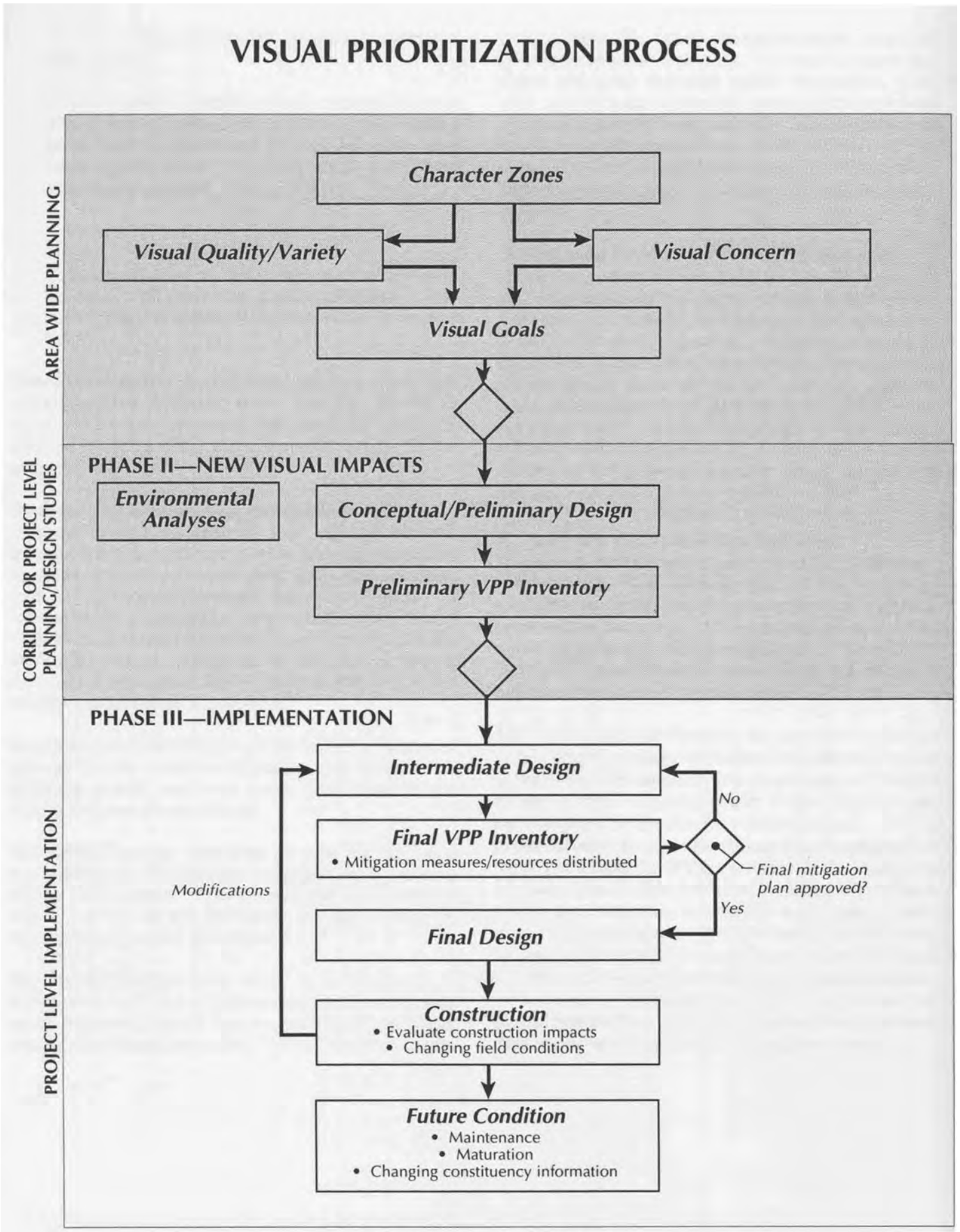


Figure 22. Flow chart, Phase III.

PHASE III—IMPLEMENTATION

This final phase of the VPP takes place after a preliminary design is selected. The plans should include horizontal and vertical alignments, construction limits, cross sections, and selected mitigation measures (figure 22). During this phase, the final design for the project level implementation is completed. It can include evaluating the construction impacts and any change in site conditions that may need to be mitigated during construction. Future maintenance needs and changing constituency information can be evaluated with the VPP. Some solutions for future mitigation may be determined now knowing that the VPP can be used to adjust the mitigation as the changes occur.

Intermediate Design

The Intermediate Design contains the actual construction plans taken to the 30 to 60 percent completion level. These plans are prepared with the results of the Preliminary VPP Inventory, the visual mitigation plan, and are incorporated in the intermediate design plans.

An example of use of the VPP during the Intermediate Design step is shown in the Mt. Lemmon Highway case study. This project utilized VPP findings to shift the alignment in response to the visual inventory of the project (Appendix B, figure B-16).

Final VPP Inventory

The next step is the Final VPP Inventory, which is a refinement of the Preliminary VPP Inventory performed in Phase II. The visual units and elements, as defined in Phase II or redefined at this juncture, are reevaluated and revised if necessary. This evaluation is based on reviewing the intermediate level plans, with cross sections, and walking the selected alignment, preferably after it has been staked. The scores of visual elements and ratings of visual priority levels are checked and finalized. Total scores for each visual unit are tallied, considering new visual elements and lost visual elements. The TVC and NVC are then checked and finalized.

At this point, the final mitigation measures are designed, including distribution along the corridor according to

Figure 23. Increased use of this lake, an important visual element along this completed project, may result in the need for new parking areas.

the factors listed in step I of the Preliminary VPP Inventory (p. 21). A final cost estimate is then prepared for these mitigation measures. The overall mitigation plan can be evaluated relative to the project budget, allowing adjustments to be made, if warranted. If construction and/or mitigation costs are excessive, the process may have to return to Phase II for reconsideration and possible redesign to reduce costs. After mitigation recommendations have been designed based on the VPP analysis, the decision to cut mitigation dollars or total project costs can be made with greater knowledge of "importance per dollar" (Appendix D).

Final Design

Once a final mitigation plan is approved, Final Design may proceed. This leads to completion of construction documents, which reflect engineering concerns as well as the visual resource mitigation measures identified previously.

Construction

The final step is Construction. VPP can also be used during construction to evaluate unforeseen conditions or impacts. Modification may be required which would necessitate returning to the final VPP inventory step. This could result in modifications to the final design features and mitigation measures. During the Mt. Lemmon Highway construction, for example, two new visual elements were identified, leading to a revised VPP inventory and design of mitigation measures.

Information from the VPP can also be used to guide maintenance decisions, as well as future management plans as the project matures (figure 23). For example, slide material can be removed and placed in low VPL areas (Appendix B, figure B-19). Changes in visual resources as they mature may lead to extra mitigation in higher VPL areas. Other visual management decisions may be guided as the opinions of constituents' priorities change over time.

CONCLUDING REMARKS

The intent of the VPP Committee, which is responsible for this *User's Manual,* is for VPP to be a useful technique, available to many agencies and professionals responsible for visual resource analysis. There is a need for a consistent approach that can be recognized by those in the field as acceptable and effective. The various agencies need to be able to understand a common methodology so that the results of different studies can be compared.

The VPP seems to be the first process to describe a way for designers to integrate elements and concerns from both engineering and landscape architecture. The VPP also offers ways to work as a team from the beginning, saving not only rework and redesign time but offering a way for those with engineering design expertise, and those practitioners with visual resource and social or recreation planning expertise, to communicate and learn from each other.

VPP is also useful during construction and maintenance, and can guide changes due to maturation of the area and/or constituency concerns. The technique is efficient and economical. The basic tools required are the understanding of the visual variables and their values, the numerical evaluation system, and field forms. A computer is not required, although 3-D imaging of proposed visual elements is useful. Also, there is an expectation that VPP software can be developed to provide for computer application.

The four case studies in Appendix B demonstrate the use and understanding of the VPP. The reader is encouraged to study these case studies thoroughly and to go back and forth between the body of this manual and the case studies. All four case studies describe projects that incorporated VPP, and as a result, identified visual priorities. Three of them amended the preliminary design accordingly, and added mitigation measures where they were needed the most. The fourth provided information to assist in determining a preferred alternative.

APPENDIX A—REFERENCES

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Mt. Lemmon Highway

Mt. Lemmon Highway

CASE STUDY NO. 1: MT. LEMMON HIGHWAY

EXAMPLE OF PARTIAL VPP THROUGH CONSTRUCTION PHASE

INTRODUCTION

The Mt. Lemmon Highway, a part of the Arizona Federal-aid secondary highway system, crosses the Coronado National Forest. The Forest Service manages national forests for natural, social, cultural, and visual resources. Maintenance of this highway is provided by the Pima County Department of Transportation and Flood Control District. Reconstruction of the existing two-lane roadway began with a 3-mile (4.83 km) project in late 1987. A second 3-mile (4.83 km) project was completed in mid-1991. Improvements included widening the two traffic lanes from 9 feet (2.7 m) to a standard 12-foot (3.7m) width, adding paved shoulders, and realigning the highway to a 30-mph (48.3 km/h) design speed.

The visual prioritization process (VPP) was first developed and applied to this project. This application of the VPP is presented as a "partial" VPP version. This streamlined example of the process considers only new visual elements of cuts and fills. Other visual factors—such as the loss of significant visual resources and other proposed visual elements—were inventoried separately.

PHASE I— EXISTING VISUAL RESOURCES

Character Zone

Mt. Lemmon Highway is a 25-mile (40.3 km) long highway between the desert city of Tucson, Arizona and the top of the Catalina Mountain Range. The highway crosses nine plant zones, from the Sonoran Desert Upland zone—2,250 feet (685.8 m) at the base of the mountains, to the Subalpine Zone—9,000+ feet (2,743.2+m) at the top of the range.

The highway scenery is characterized by steep, mountainous terrain; rough canyons; panoramic ridge and valley views; unique vegetation which changes with elevation and exposure; clear, cold-water streams enclosed by dense riparian zones; diverse wildlife; and spectacular rock formations—

Figure B-1. Characteristic view from Mt. Lemmon highway.

resulting in some of the most attractive scenery and recreational opportunities in the typically flat, arid southwestern United States. Mt. Lemmon Highway is a designated scenic highway in Pima County (figure B-1).

The Catalinas are an important visual backdrop for Tucson. The first two projects of reconstruction are along the lower 6 miles (9.7 km) of the highway. The first 4 miles (6.4 km) cross the front face of the Catalinas, facing Tucson (figure B-2).

Visual Quality/Variety

Visual resources along the highway are managed under the Visual Management System (VMS) (reference 18) of the USDA Forest Service. Under this system, the variety of the physical features of the landscape are measured to determine visual quality. The variety of landscape features viewed from the Mt. Lemmon Highway are categorized as being *distinctive*, falling into *Class A*. This rating is assigned because of the spectacular views of changing landform, rock form, vegetation, and riparian areas along the highway.

Visual Concern

The Sensitivity Level of the route measures people's concern for scenic quality, under VMS (reference 18). Mt. Lemmon Highway has a Sensitivity Level 1 rating, as it is a primary travel route, where at least one-fourth of the Forest visitors have a major concern for the scenic qualities. Many tourists drive the entire 25-mile (40.3 km) length just to view the scenery.

Visual Goals

Under the VMS, areas with Variety Class A and Sensitivity Level 1 are within the Retention Visual Quality Objective. The goal of retention is for construction activities to be unnoticeable to a forest visitor upon completion of the project. To achieve this, design elements should repeat the existing patterns of form, line, color, and texture in the landscape.

Because the project is located in the fragile, biological environment of the Sonoran Desert, and with the budget available, the Forest Service recognized initially that the retention objective could

Figure B-2. Background view of Mt. Lemmon highway from urban area.

not be met upon completion of the project. A modified visual goal was adopted for this project, to meet the *retention* objective within 3 years of completion of construction.

PHASE II—VISUAL IMPACTS

Conceptual/Preliminary Design

Federal Highway Administration (FHWA), Central Federal Lands Highway Division engineers were responsible for the highway design. An early design decision was made, based on the preliminary visual resource assessment, to consolidate fill/waste areas in low-visibility areas, rather than a more traditional approach of minimizing the haul by side casting fill material along the entire route. The alignment, as a result, shifted toward the cut side in high-visibility areas. This decision was based on the high visibility from Tucson of large sections of the lower 4 miles (6.4 km) of the highway, and the probability of greater success with mitigation on cuts. Concentrated areas of fill disposal were identified, where slopes could be flattened for better revegetation.

Preliminary Visual Prioritization Process (VPP) Inventory

On this project, cuts and fills were identified as the primary visual elements requiring mitigation. The VPP was used to inventory each proposed cut and fill as identified on the preliminary roadway design provided by FHWA, in order to determine the visual sensitivity level of each area. The mitigation measures would be concentrated on areas with greater sensitivity, and a higher visual priority level (VPL).

Conduct Detailed Visual Inventory

In addition to the VMS mapping, a visual resource assessment was initially completed in 1986 as part of the environmental assessment for the reconstruction of the Mt. Lemmon Highway. Distance zones for the visual inventory along the highway, guided by VMS recommendations, are shown in figure B-3. While the entire highway requires special attention to visual resources, the lower 4 miles (6.4 km) are especially critical visually, as long stretches are visible in the background from Tucson.

Determine Values of Inventory Variables

Six visual criteria were identified to inventory the visual sensitivity of each proposed cut and fill: (1) Distance from the viewer, (2) magnitude or scale, (3) angle of the view, (4) duration of the view at the design speed of 30 mph (48.3 km/h), (5) silhouette condition, (figure B-7) and (6) aspect. Following are

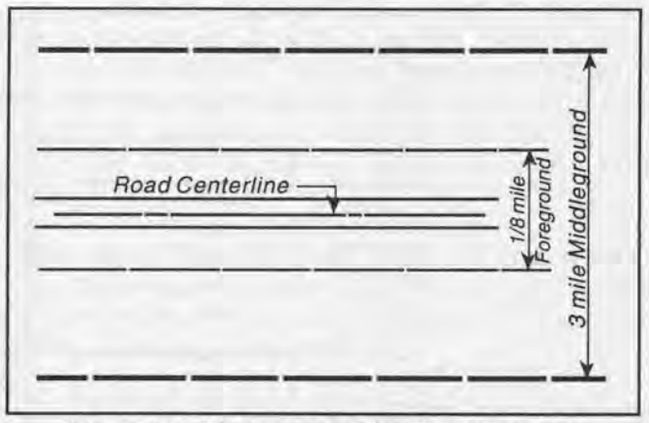


Figure B-3. Distance zones for visual inventory of Mt. Lemmon highway.

the inventory variables, their values, and the numerical scores used on this project. (Note: In this case study, "immediate foreground" was not used as a distance zone)

Inventory variables	Numerical score
1. Distance from the viewer:	N/A
Foreground: up to 1/8 mi (201.2 m)	
Middleground: 1/8 to 3 mi (201.2 km to 4.83 km)	
Background: 3+ mi (4.83+ km)	
2. Magnitude:	
0 to 600 sq ft (0 to 55.8 sq m)	1
600 to 4,000 sq ft (55.8 sq m to 371.6 sq m)	2
4,000+ sq ft (371.6+ sq m)	3
3. Angle of the view:	
46 to 90 deg (peripheral)	1
16 to 45 deg	2
0 to 15 deg (direct)	3
4. Duration of the view:	
0 to 7 sec—up to 300 ft (91.4 m)	1
7 to 12 sec—300 to 500 ft (91.4 m to 152.4 m)	2
12+ sec—500+ ft (152.4 +m)	3
5. Silhouette condition:	
No silhouette	0
Background is vegetation	1
Background is sky	2
6. Aspect:	
Angles flat, or slopes away from, viewer	1
Angles 45 deg to flat	2
Angles vertical to 45 deg	3

MT. LEMMON HIGHWAY

VPP INVENTORY-NEW VISUAL ELEMENTS

	STATION	MAGNITUDE				ANGLE				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	VPL
		I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
	CUTS, PHASE I																						
10	L 54+50 - 57+00		3	3			1	3			1	3							3	3		20	2
11	L 57+00 - 62+50		3	3	2		1	2	3		3	3	3		1	2			2	3	3	34	1
12	L 65+50 - 69+50, R 67+00 - 69+00		3	3	3		1	3	2		2	2	3						3	3	2	30	1
	CUTS, PHASE II																						
24	R 126+50 - 127+50		1				2				1				1				3			8	3
	FILLS, PHASE I																						
1	R 12+00 - 17+00			3				2				1								1		7	3
2	R 18+00 - 23+50			3				2				1								1		7	3
3	L 26+50 - 27+50, R 25+50 - 27+00			2				2				3								2		9	3
4	R 27+75 - 28+25			1				2				3								1		6	3
5	L 33+50, R 29+50 - 30+50			2				2				2								1		7	3
6	L 43+50 - 45+00, R 38+00 - 45+50		3	3			3	3			3	3								2		25	1
7	L 62+50 - 65+50		1	2			1	2			1	1								1		9	3
8	L 69+50 - 73+50, R 69+00 - 73+50		3	3	3		2	3	3		3	2	3						1	2	3	31	1
9	L 93+00, R 91+25 - 93+00		2	2	2		3	3	3		3	2	3						1	2	3	29	1
10	L 94+50 - 95+50		1	1			2	3			2	2							1	1		13	2
	FILLS, PHASE II																						
7	R 214+00 - 216+00		3	3			2	3			1	3							1	2		18	2

Figure B-4. VPP field inventory form—New Visual Elements

The following assumptions were made for the VPP inventory of this project: (1) When more than one angle of view was possible, the most sensitive angle was selected, and (2) when more than one duration of view variable applied, the most sensitive was selected.

Setup Unit VPP Inventory Forms

The inventory form was set up to include all cuts and fills on the project, with each of the variables listed, representing the values (see figure B-4). Forms list numerical scores assigned for each variable on all cuts and fills.

Perform Inventory

Each new cut and fill was inventoried, based on the preliminary cross sections, plans, and field reconnaissance. The VPP numerical scores are recorded on field inventory forms. Three cuts and three fills, with VPL ratings of 1, 2, and 3, shown in the form in figure B-4, are presented as examples of this process. A photo and description of each numerical rating assigned for the cuts and fills follows.

a) Example 1:
Cut 11, Project 1,
Station 57+00 - 62+50 L—VPL 1

Cut 11 on project 1 of the Mt. Lemmon Highway reconstruction is a 55-ft (16.8 m) cut, the highest cut on the first project. Approximately 19,000 sq ft (1,765.1 sq m) of cut surface is proposed. Under magnitude variable, 19,000 sq ft (1,765.1 sq m) is in the value range with a numerical score of 3 (see figure B-5).

The angle of view from the foreground (in a vehicle) is peripheral, and is scored 1. The duration of view while traveling at the design speed of 35 mph (56.4 km/h), is 15 sec, and is scored 3.

The cut is silhouetted against vegetation from the foreground view, and is scored 1. The aspect of the cut view from the foreground is nearly vertical, scored 3. The middleground view of the cut is shown as viewed from a lower section of the highway (see figure B-6). Although the entire cut is not visible, over 5,000 sq ft (464.5 sq m) of the proposed new cut can be seen from this area, and the cut receives a 3 scoring for magnitude.

The angle of view from the middleground ranges between 16 and 45 deg, and is scored 2. The duration of view from this area is over 12 sec and is scored 3. The aspect of the cut viewed from the middleground is nearly vertical, scored 3.

Figure B-5. Cut 11, VPL 1—Foreground view from the highway, before reconstruction.

Figure B-6. Cut, VPL 1—Middleground view from lower section of highway.

Figure B-7. Cut 11, VPL 1—Silhouette against sky, viewed from lower section of highway.

Figure B-8. Cut 11, VPL 1—Background view of the cut from residential area.

Figure B-9. Cut 10, VPL 2—Middleground view from lower section of highway.

A different middleground view, also from a lower section of the highway, shows a sharp silhouette against the sky, resulting in a 2 score (see figure B-7). Only a portion of Cut 11 is visible from the background view in Tucson, resulting in a 2 score for magnitude (see figure B-8). The angle of view from the background is direct, scored 3.

The duration of view from the background is continuous and is scored 3. There is no silhouette view from the background. The aspect of the cut from the background is nearly vertical, scored 3 (see figure B-8).

b) Example 2:
Cut 10,
Project 1,
Station 54+50 - 57+00 L —VPL 2

This cut is visible from the foreground and middleground distance zones, but is not visible from the background. The magnitude of this proposed cut, viewed from the middleground, is 6,000 sq ft (557.4 sq m), scored 3 (see figures B-5 and B-9).

The angle of view from the middleground is direct, scored 3. The duration of view from the middleground is approximately 1-1/2 min at the design speed of 35 mph (56.4 km/h), and is scored 3. The aspect of the cut viewed from the middleground is nearly vertical, scored 3.

There is not a silhouette view from the middleground or the foreground.

The entire proposed cut of 6,000 ft (1,828.8 m) is visible from the foreground, and is scored 3 for magnitude (see figure B-10).

The angle of view from the foreground is peripheral, and is scored 1. The duration of view from the foreground is slightly under 7 sec, scored 1. The aspect of the cut viewed from the foreground is nearly vertical, scored 3.

c) Example 3:
Cut 24,
Project 1,
Station 126+50 - 127+25 R—VPL 3

Cut 24, Project 1, located on the inside of a curve, is visible from only the foreground view (see figure B-11).

The magnitude is scored 1 with a proposed cut face surface of 575 sq ft (53.4 sq m). The angle of view is an average of 30 deg, and is scored 2.

Figure B-10. Cut 10, VPL 2—Foreground view.

Figure B-11. Cut 24, VPL 3—Foreground view.

Figure B-12. Fill 8, VPL 1—Middleground view from the highway.

The silhouette condition is against vegetation, and is scored 1. The duration of view is less than 2 sec, scored 1.

d) Example 4:
Fill 8,
Project 1,
Station 69+50 - 73+50 R—VPL 1

The large fill at Station 69+50 to 73+50 is one of the designated waste areas and is visible from the foreground, middleground, and background (see figure B-12).

The magnitude at all distance zones is scored 3, as the new fill is approximately 20,000 sq ft (1,860 sq m).

The angle of view is approximately 30 deg at the foreground view, scored 2. The middleground and background views are direct, scored 3.

The duration of view for Fill 8, from the foreground, is approximately 20 sec, scored 3. From the middleground, the duration of view is slightly over 7 sec, scored 2 (see figure B-12).

The continuous background view, where the fill is visible from a residential area, results in a 3 score for duration of view.

There is not a silhouette condition for this fill area (see VPP inventory form, figure B-4).

e) Example 5:
Fill 7,
Project 2,
Station 214+00 - 216+00 R —VPL 2

Fill 7 on project 2 of the Mt. Lemmon Highway reconstruction is visible from a foreground and middleground view (see figure B-13). The magnitude is scored 3 from both distance zones, with approximately 20,000 sq ft (1,858 sq m) proposed in the fill.

The foreground angle of view is approximately 30 deg, scored 2. When viewed from the middleground, the view ranges from 30 deg to direct and is scored a 3, selecting the most sensitive viewing angle (see figure B-13).

Figure B-13. Fill 7, Project 2, VPL 2—Middleground view from upper section of highway.

The duration of the foreground view is 6 seconds, and scored 1. The middleground view duration can be considered constant (at the scenic overlook) and is scored 3.

The aspect is scored 1 at the foreground distance zone, as the slope drops away from the viewer. It is scored 2 at the middleground distance zone, as the slope is less than 45 deg from the observer when viewed from this area.

There is no silhouette condition.

f) Example 6:
Fill 3,
Project 1,
Station 25+50 - 27+50 R—VPL 3

Fill 3 on project 1 of the Mt. Lemmon Highway project is visible only from the middleground view (see figure B-14). With a proposed size of 3,500 sq ft (325.6 sq m), the fill was scored 2 for magnitude.

The angle of view ranges from approximately 20 to 40 deg, and is scored 2. The duration of the middleground view is approximately 31 sec, scored 3.

The aspect of the middleground view is less than 45 deg, and is scored 2. There is no silhouette condition (see figure B-15).

Tally Total Value

After the preliminary inventory, the totals of the scores for each cut and fill were added, which resulted in the VPL ratings. For the Mt. Lemmon Highway project, the VPL ratings were:

VPL 1: scores of 21+
VPL 2: scores of 11 to 20
VPL 3: scores of 1 to 10.

PHASE III—IMPLEMENTATION

Intermediate Design

Based on the preliminary VPP and field review during project 2 of the Mt. Lemmon Highway project, an alignment shift was incorporated into the design. A unique rock structure, which was a strong visual feature in the area, was identified at Station 230+00 (R) (see figure B-16).

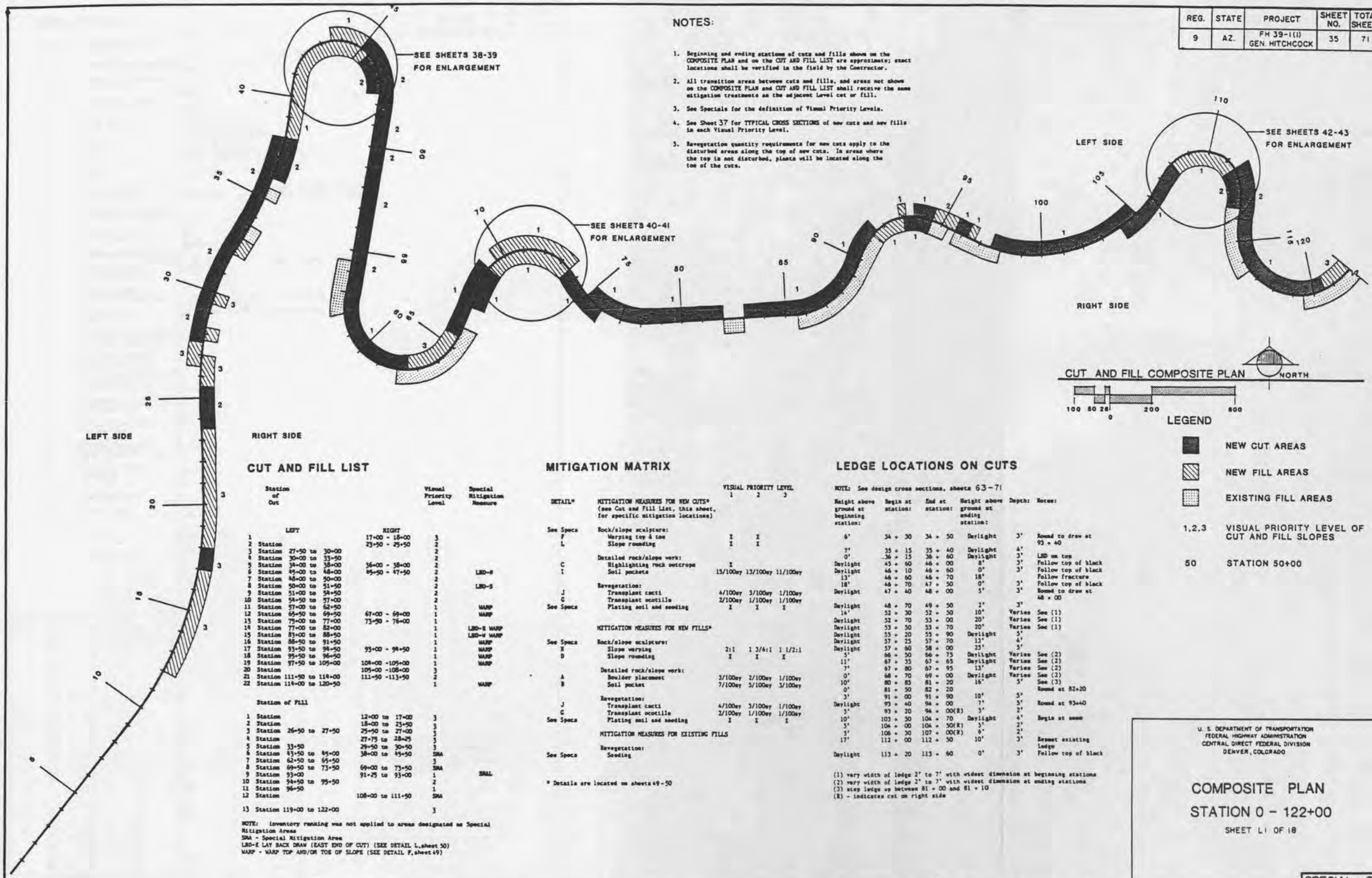
The shift in the alignment, with increased cut on the left to leave the rock formation in place, is an

Figure B-14. Fill 3, Project 1, VPL 3—Middleground view from the highway.

Figure B-15. Fill 3, Project 1, VPL 3—Middlegroundview from the highway.

Figure B-16. Unique rock structure saved during design by alignment shift.

REG.	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	AZ.	FH 39-1(1) GEN. HITCHCOCK	35	71



NOTES:

1. Beginning and ending stations of cuts and fills shown on the COMPOSITE PLAN and on the CUT AND FILL LIST are approximate; exact locations shall be verified in the field by the Contractor.
2. All transition areas between cuts and fills, and areas not shown on the COMPOSITE PLAN and CUT AND FILL LIST shall receive the same mitigation treatments as the adjacent Level cut or fill.
3. See Specials for the definition of Visual Priority Levels.
4. See Sheet 37 for TYPICAL CROSS SECTIONS of new cuts and new fills in each Visual Priority Level.
5. Revegetation quantity requirements for new cuts apply to the disturbed areas along the top of new cuts. In areas where the top is not disturbed, plants will be located along the toe of the cuts.

CUT AND FILL COMPOSITE PLAN

NORTH

100 50 25 0 200 800

LEGEND

- NEW CUT AREAS
- NEW FILL AREAS
- EXISTING FILL AREAS
- 1,2,3 VISUAL PRIORITY LEVEL OF CUT AND FILL SLOPES
- 50 STATION 50+00

CUT AND FILL LIST

	Station of Cut			Visual Priority Level	Special Mitigation Measure
	LEFT		RIGHT		
1			17+00 - 18+00	3	
2	Station		23+50 - 25+50	2	
3	Station 27+50 to	30+00		2	
4	Station 30+00 to	33+50		2	
5	Station 34+00 to	38+00	36+00 - 38+00	2	
6	Station 45+00 to	48+00	45+50 - 47+50	2	LBD-N
7	Station 48+00 to	50+00		2	
8	Station 50+00 to	51+50		2	LBD-S
9	Station 51+00 to	54+50		2	
10	Station 54+50 to	57+00		2	
11	Station 57+00 to	62+50		1	WARP
12	Station 65+50 to	69+50	67+00 - 69+00	1	WARP
13	Station 75+00 to	77+00	73+50 - 76+00	1	
14	Station 77+00 to	83+00		1	LBD-E WARP
15	Station 83+00 to	88+50		1	LBD-W WARP
16	Station 88+50 to	91+50		1	WARP
17	Station 93+50 to	94+50	93+00 - 94+50	1	WARP
18	Station 95+50 to	96+50		1	WARP
19	Station 97+50 to	105+00	104+00 -105+00	1	WARP
20	Station		105+00 -108+00	3	
21	Station 111+50 to	114+00	111+50 -113+50	2	
22	Station 114+00 to	120+50		1	WARP
	Station of Fill				
1	Station		12+00 to 17+00	3	
2	Station		18+00 to 23+50	3	
3	Station 26+50 to	27+50	25+50 to 27+00	3	
4	Station		27+75 to 28+25	3	
5	Station 33+50		29+50 to 30+50	3	
6	Station 43+50 to	45+00	38+00 to 45+50	SMA	
7	Station 62+50 to	65+50		3	
8	Station 69+50 to	73+50	69+00 to 73+50	SMA	
9	Station 93+00		91+25 to 93+00	1	SMA1
10	Station 94+50 to	95+50		2	
11	Station 96+50			1	
12	Station		108+00 to 111+50	SMA	
13	Station 119+00 to	122+00		3	

NOTE: Inventory ranking was not applied to areas designated as Special Mitigation Areas
SMA - Special Mitigation Area
LBD-E LAY BACK DRAW (EAST END OF CUT) (SEE DETAIL L, sheet 50)
WARP - WARP TOP AND/OR TOE OF SLOPE (SEE DETAIL F, sheet 49)

MITIGATION MATRIX

DETAIL*	MITIGATION MEASURES FOR NEW CUTS* (see Cut and Fill List, this sheet, for specific mitigation locations)	VISUAL PRIORITY LEVEL 1	2	3
See Specs	Rock/slope sculpture:			
F	Warping top & toe	X	X	
L	Slope rounding	X	X	
	Detailed rock/slope work:			
C	Highlighting rock outcrops	X		
I	Soil pockets	15/100sy	13/100sy	11/100sy
	Revegetation:			
J	Transplant cacti	4/100sy	3/100sy	1/100sy
G	Transplant ocotillo	2/100sy	1/100sy	1/100sy
See Specs	Plating soil and seeding	X	X	X
	MITIGATION MEASURES FOR NEW FILLS*			
See Specs	Rock/slope sculpture:			
H	Slope warping	2:1	1 3/4:1	1 1/2:1
D	Slope rounding	X	X	X
	Detailed rock/slope work:			
A	Boulder placement	3/100sy	2/100sy	1/100sy
B	Soil pocket	7/100sy	5/100sy	3/100sy
	Revegetation:			
J	Transplant cacti	4/100sy	3/100sy	1/100sy
G	Transplant ocotillo	2/100sy	1/100sy	1/100sy
See Specs	Plating soil and seeding	X	X	X
	MITIGATION MEASURES FOR EXISTING FILLS			
	Revegetation:			
See Specs	Seeding			

* Details are located on sheets 49 - 50

LEDGE LOCATIONS ON CUTS

NOTE: See design cross sections, sheets 63 - 71

Height above ground at beginning station:	Begin at station:	End at station:	Height above ground at ending station:	Depth:	Notes:
6'	34 + 30	34 + 50	Daylight	3'	Round to draw at 93 + 40
7'	35 + 15	35 + 40	Daylight	4'	
0'	36 + 15	36 + 60	Daylight	3'	LBD on top
Daylight	45 + 90	46 + 00	8'	3'	Follow top of black
Daylight	46 + 10	46 + 60	0'	3'	Follow top of black
13'	46 + 60	46 + 70	18'		Follow fracture
18'	46 + 70	47 + 50	0'	3'	Follow top of black
Daylight	47 + 40	48 + 00	5'	3'	Round to draw at 48 + 00
Daylight	48 + 70	49 + 50	2'	3'	
14'	52 + 30	52 + 50	10'	Varies	See (1)
Daylight	52 + 70	53 + 00	20'	Varies	See (1)
Daylight	53 + 50	53 + 70	20'	Varies	See (1)
Daylight	55 + 20	55 + 90	Daylight	5'	
Daylight	57 + 25	57 + 70	13'	4'	
Daylight	57 + 60	58 + 00	25'	5'	
5'	66 + 50	66 + 75	Daylight	Varies	See (2)
11'	67 + 35	67 + 65	Daylight	Varies	See (2)
7'	67 + 80	67 + 95	13'	Varies	See (2)
0'	68 + 70	69 + 00	Daylight	Varies	See (2)
10'	80 + 85	81 + 20	16'	5'	See (3)
0'	81 + 50	82 + 20			Round at 82+20
3'	91 + 00	91 + 90	10'	5'	
Daylight	93 + 40	94 + 00	7'	5'	Round at 93+40
5'	93 + 20	94 + 00(E)	5'	2'	
10'	103 + 50	104 + 70	Daylight	4'	Begin at seam
5'	104 + 00	104 + 50(E)	5'	2'	
5'	106 + 30	107 + 00(E)	6'	2'	
17'	112 + 00	112 + 50	10'	3'	Repeat existing ledge
Daylight	113 + 20	113 + 60	0'	3'	Follow top of black

(1) vary width of ledge 2' to 7' with widest dimension at beginning stations
(2) vary width of ledge 2' to 7' with widest dimension at ending stations
(3) step ledge up between 81 + 00 and 81 + 10
(E) - indicates cut on right side

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COMPOSITE PLAN
STATION 0 - 122+00
SHEET L1 OF 18

SPECIAL - 8

Figure B-17. Project 1 Composite plan, sheet L1, Mt. Lemmon Highway.

REG.	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	AZ	FH 39-1(3) GENERAL HITCHCOCK	66	100

Material List

LABEL	SCIENTIFIC NAME / COMMON NAME	QUANTITY	SIZE/ COND.	# 1 GPH EMITTERS
	Salvaged plant material			
S1	Opuntia engelmannii Prickly pear	167	2 - 10 pads/BR	0
S2	Ferocactus wislizeni Barrel cactus	21	1 - 2' BR	0
S3	Agave sp. Century plant	79	1 - 3' BR	1
S4	Yucca sp. Yucca	2	BR	1
S5	Yucca sp. Yucca	2	15 gal	4
S6	Dasylirion wheeleri Desert Spoon	13	5 gal	1
S7	Cercidium microphyllum Foothill paloverde	2	30" box	10
S8	Prosopis velutina Velvet mesquite	1	48" box	14
	Container grown plant material			
C1	Celtis pallida Desert hackberry	32	1 gal	1
C2	Rhamnus crocea Hollyleaf buckthorn	27	1 gal	1
C3	Quercus emoryi Emoryi oak	84	3 gal	4
C4	Cercidium microphyllum Foothill paloverde	20	5 gal	4
C5	Prosopis velutina Velvet mesquite	71	5 gal	4
C6	Vauquelinia californica Arizona rosewood	63	5 gal	4
C7	Ziziphus obtusifolia Greythorn	32	5 gal	4
C8	Fraxinus velutina Velvet ash	11	5 gal	6
C9	Populus fremontii Fremont Cottonwood	3	5 gal	6
C10	Platanus wrightii Sycamore	4	5 gal	6
	Inert material			
S	Plating soil			
B	Boulder	76	1/3 to 1 cu.yd.	
T	Irrigation tank	24	varies (see sheet 57)	

Irrigation Material Schedule

SYMBOL	MANUFACTURER/MODEL	DESCRIPTION
•	Spears	2" x 1 1/2" reducer bushing, Sch 80 pvc thread by thread
■	Spears	1" pvc tank adapter
⊠	FLO Control	1" plastic foot screen
□	Spears	1" x 1" male adapter insert
	Mundo SA1GVI	1" gate valve
⊡	Hardie 420-1"-155	1" Y-filter w/ 155 mesh screen
⊏	Hardie VVAO 201	1/2" drain/flush valve at ends of all poly lines
	Irridelco KF Micro Flapper	pressure compensating 1 gph drip emitter
	Irridelco KFS Micro Flapper	pressure compensating 1 gph drip emitter w/ 5 outlets
———	Hardie Dura-pol EHS81648	polyethylene tubing 1" (1.049" ID)
— — —	"	3/4" (.824" ID)
– – – – –	"	1/2" (.613" ID)
○	FLO Control series 1205-1"	pvc adjustable check valve, set at 5 lbs.
	Agricultural Products 187 x 125 - 100	3/16" micro tubing

Mitigation Matrix

DETAIL	MITIGATION MEASURE	VISUAL PRIORITY LEVEL 1	2	3
	FOR NEW CUT:			
	Rock/slope sculpture:			
F	Warping top/toe	x	x	
L	Slope rounding	x	x	
M	Closely spaced drill holes with staggered alignment on upper lift; more widely spaced drill holes on lower lift	x	x	
(See Note 1)	Closely spaced drill holes with staggered alignment	x	x	x
	Detailed rock/slope work:			
I	Soil pockets	15/100sy	13/100sy	11/100sy
L	Ledge (see Note 2)	1/200lf	1/300lf	1/500lf
	MITIGATION MEASURE FOR NEW FILL:			
	Rock/slope sculpture:			
M	Slope warping	2:1	1 3/4:1	1 1/2:1
D	Slope rounding	x	x	x

NOTES:
1. Applies to cuts listed on Sheet 2. See photo example, Sheet 66, at Station 119+00L.
2. Minimum ledge length is 25'; minimum depth is 2'.

Visual Inventory

VISUAL PRIORITY LEVELS: CUTS

#	VPL	LEFT	RIGHT
1	1	158+00 - 161+00	159+00 - 163+00
2	1	166+50 - 170+00	
3	1	171+50 - 176+00	
4	1	176+00 - 183+00	
5	1	185+00 - 191+50	
6	2		193+50 - 195+00
7	1		197+70 - 201+20
8	1	207+00 - 213+50	
9	2		217+00 - 218+50
10	1	228+00 - 230+00	227+40 - 228+50
11	1	231+50 - 240+00	
12	2		245+00 - 246+50
13	1	252+50 - 260+25	
14	3	261+75 - 264+00	
15	2	265+50 - 272+50	
16	3	276+50 - 277+60	275+00 - 277+00
17	2	278+80 - 285+50	
18	2	288+50 - 293+50	
19	2		296+00 - 300+50
20	3	310+50 - 314+00	
21	3	320+50 - 321+50	
22	1		328+00 - 335+00
23	1		339+00 - 342+50

VISUAL PRIORITY LEVELS: FILLS

#	VPL	LEFT	RIGHT
1	1	165+00 - 165+75	
2	3	183+50 - 184+50	
3	3		
4	2		
5	3		
6	2		205+00 - 207+00
7	2		214+00 - 216+00
8	2		
9	2		
10	2	230+00 - 231+00	
11	3	240+50 - 244+50	240+50 - 244+50
12	1		249+00 - 252+50
13	1	260+50 - 261+00	
14	3		264+00 - 267+00
15	3		272+50 - 275+00
16	3	278+00 - 278+60	
17	1	286+00 - 287+00	286+00 - 288+00
18	1	294+00 - 295+50	293+50 - 295+50
19	1	298+00 - 300+50	
20	2	307+50 - 309+50	
21	3	314+00 - 317+00	
22	1	322+50 - 328+50	
23	1	336+00 - 338+00	337+50 - 339+00

PLANTING AREA	SHEET NO.	S1	S2	S3	S4	S5	S6	S7	S8	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	BOULDER	TOTAL GPH	TOTAL GAL	TANK SIZE	TANK STATION	1" POLY LN.FT.
1	51	4	1							9			2	8							49	98	280	178+00 RT	1700
2	"	2	2							4			1	2							16	32	100	179+50 LT	1400
3	"		1							3			2	1							15	30	100	185+00 RT	1500
4	52									4			3	5							36	72	280	207+00 RT	1500
5	"	10	3							2			5	10	5	7				5	110	220	500	216+22 RT	1720
6	53	4	4		1					2			5	10	1	3				6	79	158	500	227+30 RT	1200
7	"									7			2	6	4	2					63	126	500	235+30 RT	1500
8	"	5	2				1			1				2	2	1				3	22	44	100	249+50 LT	1850
9(242R)	58	18		3			1					1		5	3	1				6	44	88	500	253+00 RT	1000
10(242L)	"	8		6								4		7	4					7	66	132	280	256+20 LT	1200
11(251)	59	9		5								6		4	4	1				6	65	130	280	266+00 RT	1500
12(254)	63	9	3			2	2	2	1			2		4		2				8	76	152	280	271+00 RT	1600
13	54	3	1									1		1	1					1	12	24	100	273+50 LT	1200
14	"	1	1	4			1					2		2	2	1				1	33	66	280	276+50 RT	1200
15(274)	60	6		3								4		3	2	1				4	43	86	100	284+75 RT	1100
16	55	10	3	5	1		2					7		1	3						52	104	280	300+00 RT	2200
17	"			6			1				5	3				2	4	2		3	68	136	500	310+00 LT	2300
18	"										6	11			1	3	3	1	1		96	192	280	309+00 RT	1500
19	"	6		5			1				3				4	3				2	37	74	500	313+50 LT	1900
20	56	6		9			2				10	10			4	2	4			3	109	218	500	320+20 LT	1700
21	"	10		2											4				3	1	36	72	280	317+60 RT	1000
22	"	9		6			1				3	9			3	1				3	62	124	280	326+50 LT	1000
23	"	4		3											2	1					15	30	500	338+50 LT	1300
(325)	61	30		6								19			6					12	106	212	"	"	"
24	57	5		4			1								2	1				1	17	34	280	350+00 LT	1000
(337)	62	8		5								5			6					4	49	98	"	"	"
TOTAL		167	21	72	2	2	13	2	1	32	27	84	20	71	63	32	11	3	4	76	1376	2752		24 REQ'D	35070

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LANDSCAPING SCHEDULES

SHEET 16 OF 18
SPECIAL-12

Figure B-18. Project 2 Landscaping schedules, sheet 16, Mt. Lemmon Highway.

example of highway design responding to the preliminary VPP findings during the early highway design process.

Final VPP Inventory

The preliminary VPP was finalized, with the final cut and fill stationing and field checking, and adjusting the subsequent inventory results accordingly. Each cut and fill was checked in the field according to the scores, total inventory points received, and the VPL rating scale for appropriateness and comparative treatments.

The final VPP inventory was incorporated into the construction documents on projects 1 and 2 of the Mt. Lemmon Highway reconstruction. Project 1 contract plans include a Cut and Fill Composite Plan, where the VPL of each cut and fill is indicated (see figure B-17). The project 1 cuts and fills previously shown as examples of the different VPL's are highlighted on the Composite Plans, and are also included in the Cut and Fill List. The project 2 contract plans indicate the VPL of each new cut and fill in the Visual Inventory (see figure B-18). The contract documents also include the mitigation measures and quantities required for each VPL.

Evaluate Overall Mitigation Plan

The mitigation measures on these two projects of the Mt. Lemmon Highway project were distributed to each new cut and fill according to their VPL rating (see Mitigation Matrix, figures 17 and 18). Consequently, the cuts and fills with the highest visual sensitivity received the most mitigation effort, which maximized the effectiveness of mitigation expenditures.

The unit costs of mitigation for the VPL 1, 2, and 3 cut and VPL 1, 2, and 3 fill on the Mt. Lemmon Highway project are shown below:

CUT	VPL 1	VPL 2	VPL 3
Excavation details (including specialized blasting):			
• Ledges, warping, rounding, and highlighting rock outcrops	0.60	0.45	0.32
• Soil pockets	0.11	0.08	0.06
• Revegetation	0.20	0.15	0.10
Total cost/sq ft:	$0.91	0.68	0.48
($/sq m)	($9.80)	(7.32)	(5.71)
FILL			
Embankment details:			
• Warping	0.08	0.06	0.04
• Rounding	0.01	0.01	0.01
• Staggered ledges	0.13	0.10	0.07
• Boulders	0.04	0.03	0.02
• Revegetation	0.26	0.20	0.14
Total cost/sq ft:	$0.52	0.40	0.28
($/sq m)	($5.60)	(4.31)	(3.01)

The total mitigation costs for this project were approximately 15 percent of the total project cost.

Final Design

The final mitigation costs, together with the roadway costs, were evaluated during final design. The mitigation measures were not reduced during final design, as is often the case when budget constraints occur, due to the degree of detail in distributing the mitigation dollars where they would be most effective. Alternate project lengths were bid to keep the final project within the budget.

Construction

The VPP process was used during the construction of the second project, where two new fill areas were added. One fill area, which replaced a planned retaining structure, was rated as a VPL 1. This area was an existing rocky fill without revegetation, so the added fill with mitigation was an improvement over the existing condition. Associated levels of mitigation were added by a change order. The other fill area was located to waste excess material in a VPL 3 location, to avoid additional impacts to visually sensitive areas.

The VPP inventory results continue to be used during roadway maintenance activities. Ditch debris and material storage is hauled to low visibility VPL 3 fill areas designated for excess material (see Figure B-19).

Evaluation of Partial VPP

The range of mitigation quantities for VPL 1, 2, and 3 reflect the natural range of variety found in the Sonoran Desert ecosystem, regarding plant density, variety of terrain, and rock outcroppings.

A typical design approach is to determine mitigation for a project and apply the mitigation uniformly throughout the areas of impact. Even on a roadway of high visual sensitivity, such as the Mt. Lemmon

Highway with Retention as a Visual Quality Objective, visual sensitivity varies. The VPP was used to identify this variation and distribute mitigation accordingly.

It is difficult to predict the outcome of this project if this approach was not developed. Most likely, a level of mitigation would have been proposed for the entire project. When budget constraints were applied, the mitigation likely would have been cut, either in size or quantity of plants, amount of soil, or effort in specialized grading and blasting techniques.

The result could have been a uniform VPL 2 application of mitigation measures throughout the entire project. Although the costs may have been the same or similar, the effectiveness would have been lessened considerably, with VPL 1 areas receiving inadequate mitigation and VPL 3 areas receiving more than needed.

Visual resource goals were achieved on the Mt. Lemmon Highway project. The following photographs show the inventoried cuts and fills after completion of construction, with the varying levels of mitigation measures applied according to the VPL (see figures B-20, B-21, B-22, B-23, B-24 and B-25).

SUMMARY

The Mt. Lemmon Highway case study presents the application of a partial VPP analysis that addressed only the prominent visual impacts of cut and fill on a roadway project. The process was successfully utilized from the preliminary design through final design stages, and was incorporated into the construction documents. The VPP process was also applied during the changing field conditions during construction to achieve consistent visual goals.

The application of the partial VPP may be useful on projects where visual impacts are concentrated to a minimal number of elements, as in the case of cuts and fills on Mt. Lemmon Highway, or where time and available resources prevents a complete VPP inventory. The significant visual elements must be defined for each project. In this case, inventory of the *loss of significant visual resources* for the entire project would have been useful during the preliminary design phase, if it had been incorporated into the VPP. The partial application of VPP was successful in achieving visual goals and distributing mitigation dollars with economic efficiency. Results continue to be utilized for maintenance activities.

The next case study shows a complete VPP analysis on a roadway in the preliminary design phase.

Figure B-19. After heavy rains, slide material from unimproved portions of the roadway is cleared and hauled to a designated VPL 3 waste site.

Figure B-20. Cut 11, VPL 1, 3 years after construction (see figure B-5 for comparison).

Figure B-21. Cut 11, viewed from middleground (see figure b-6 for comparison).

Figure B-22. Cut 10, VPL 2,3 yr after construction (see figure B-10 for comparison).

Figure B-23. Cut 24, VPL 3, 3 years after construction (see figure B-11 for comparison).

Figure B-24. Fill 8, VPL 1, 3 years after construction (see figure B-12 for comparison).

Figure B-25. Fill 3, VPL 3, 3 years after construction (see figure B-15 for comparison).

Navajo Bridge

CASE STUDY NO. 2: NAVAJO BRIDGE

INTRODUCTION

The Navajo Bridge project includes the design and construction of a new bridge over the Colorado River, and the adaptive reuse of the historic bridge as a pedestrian facility, near Lee's Ferry, in Northern Arizona (see figure B-26). The project also includes the realignment and construction of State Highway 89A as it approaches the new bridge from both directions, at a design speed of 45 mph (72.5 km/h). The project was 0.8 miles (1.29 km) long. The highway reconstruction and maintenance are funded by the Arizona Department of Transportation.

The highway goes through the Navajo Nation on the east side of the bridge, and the Glen Canyon National Recreation Area, managed by the National Park Service, on the west side of the bridge. The bridge crosses the Grand Canyon National Park, also managed by the National Park Service.

This case study demonstrates the complete VPP—including the inventory of proposed, new visual elements and the loss of existing, significant visual elements, as applied through the preliminary design phase.

PHASE I—EXISTING VISUAL RESOURCES

Character Zones

The existing visual character at the project site is defined largely by strong contrast in geologic and vegetative features located in Marble Canyon and the surrounding Kaibab Plateau. Marble Canyon's associated riparian vegetation and dramatic rock formations are prominent visual features in the region, surrounded by the expansive terrain, and low, sparse vegetation of the plateau (see figure B-27). The Navajo Bridge is a strong visual element associated with defining the character of the site. The bridge, built in 1928, is listed on the National Register of Historic Places.

Visual Quality/Variety

Variety of the existing landscape was defined according to the conditions found within the characteristic landscape, as follows:

Outstanding—High degree of variety within the defining visual elements of the natural and built environment (vegetation, water, geology and structures), visual cohesiveness,

Figure B-26. The historic Navajo Bridge crossing the Colorado River.

Figure B-27. Expansive views and dramatic rock formations in the Navajo Bridge area.

significant native vegetation in good condition, and structures introduced elements respond to the natural and cultural resources of the site. Included, also, are elements that respond and are well maintained, unique features and focal points of interest, panoramic views, and visible natural drainages.

Typical—Average amount of variety within the defining visual elements of the natural and built environment, native and introduced species are in average condition; structures and introduced elements are generally in character with the surrounding area, and are in average condition, with average views.

Below Average/Incongruous—Monotonous visual elements or excessive amounts of elements with no cohesiveness, natural features have been disturbed, vegetation is in poor or declining condition, structures and introduced elements do not relate to the character of the area and are not well maintained, little or no variety in form, line, color, or texture of geology and vegetation.

The existing visual quality of the area is described in Phase II, the Detailed Visual Inventory.

Visual Concern

Visual concern is twofold: Concern for the visual quality for visitors traveling along the route and those adjacent to and within viewing distance of the route. Highway 89A is a primary route in the area and receives a high percentage of recreationists en route to Lee's Ferry, the North Rim of the Grand Canyon, and other regional recreational attractions. The Visual Concern, or concern of roadway travelers for visual quality, was determined to be high, because of a relatively high percentage of highway users having a strong interest in visual quality and scenery.

Visual concern of adjacent landowners/managers was defined according to a combination of:

- Existing attention to visual quality demonstrated by landowner/manager
- Existing and proposed land uses
- Public participation.

Ratings were assigned as follows:

High—Landowners/managers have an above average concern for visual resources.

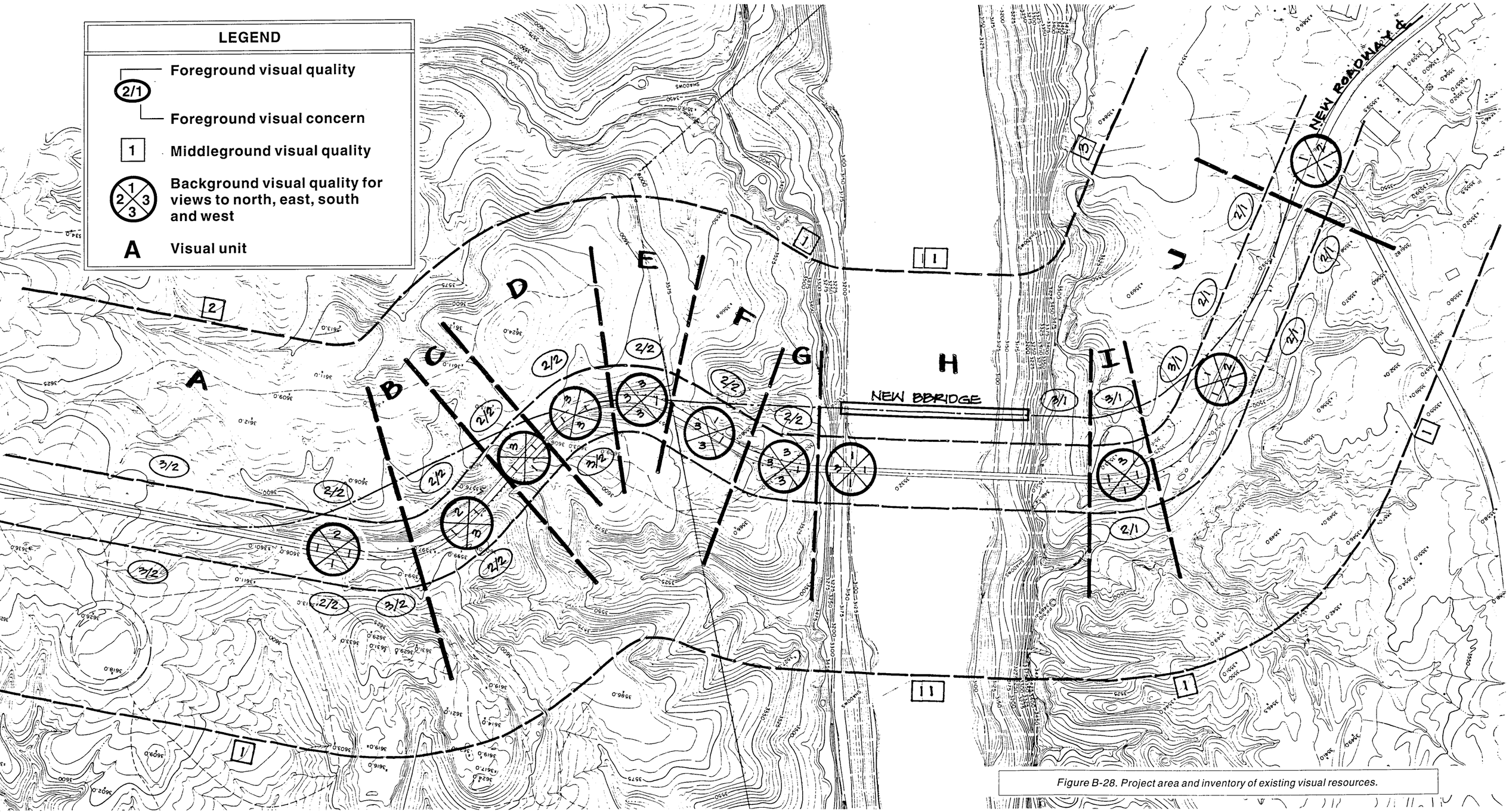


Figure B-28. Project area and inventory of existing visual resources.

Average—Landowners/managers have an average concern for visual quality.

Low—landowners/managers have a below average concern for visual quality.

Visual Goals

The goals for the Navajo Bridge project is to protect significant design elements, integrate new design elements, and mitigate construction activities so that, following construction, the new design elements will compliment the characteristic landscape, and disturbed areas will blend into the natural landscape and will not be evident.

PHASE II—VISUAL IMPACTS

Conceptual/Preliminary Design

The preliminary design of the new bridge approach roads increases the design speed to 55 mph (88.6 km/h) on the Navajo side and 45 mph (72.5 km/h) on the NPS side (see figure B-28). The historic bridge and the new bridge will come into view slightly earlier than the existing view sequence, but will still be a surprise for the first-time visitor.

Preliminary VPP Inventory

Conduct Detailed Visual Inventory

The existing approach to the Navajo Bridge is marked by continuous, expansive views of the characteristic landscape until beginning the descent toward the bridge. Views of the bridge are blocked by terrain until rounding the last curve, on both sides, when the bridge, Marble Canyon, and the Colorado River all come into view. This dramatic view is the highlight of the trip through the area, and usually a nice surprise for the first-time visitor.

1. Distance Zones

The project area was inventoried according to distance zones and viewing areas calculated for the design speed of 45 mph (72.5 km/h) and field checked for this landscape character type. The angle of vision at the 45 mph (72.5 km/h) design speed is 57-1/2 deg; and the focusing distance is 1,250 ft (381 m). With the existing roadway centerline centered in the immediate foreground, distance zone widths determined for this project are (see figure B-29):

Immediate foreground	200 ft (60.96 m)
Foreground	1,200 ft (365.8 m)
Middleground	5 mi (8.05 km)
Background	5+ mi (8.05+ km)

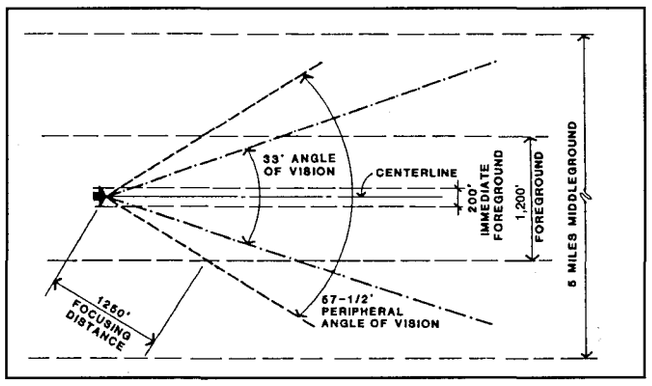


Figure B-29. Distance zones and angle of vision for Navajo Bridge.

Based on changes in views and the sequential viewing experience traveling in both directions, the corridor was broken into eight visual units. The foreground, middleground, and background portions of the project area were inventoried for existing visual quality (variety). The immediate foreground is addressed in the VPP inventory.

Following is a summary of the visual quality inventory (see figure B-28):

- The existing, foreground visual quality at the Navajo Bridge site is rated "outstanding" due to the large amount of variety in the defining visual elements of the natural and built environment. The graceful element of the existing bridge, views of the Colorado River in the midst of an arid region, richness of form, line, color, and texture of the canyon geology, and thicker, taller, and more diverse vegetation along the river bank all combine to create a high degree of visual variety. Introduced, "built" elements, in addition to the bridge, include the roadway, cuts and fills along the road, commercial stands on the Navajo side, and a ramada and parking area on the Park Service side of the bridge.

- The roadway alignment fits into the existing terrain, with the existing cuts retaining irregularities and blending with the landscape. Existing fills are not highly visible from the roadway, parking area, or river. The ramada, near the parking area, is constructed of native stone and wood, and is in character with the area.

- Due to off-road vehicle disturbances on the Navajo side of the bridge, visual quality is lowered to an "average" rating in a relatively small area.

• The paved parking area is rated "below average" in visual quality, as it is not well defined and is in declining condition. Middleground ratings are primarily "average" on the Navajo side of the bridge and "outstanding" on the bridge and on the Park Service side of the bridge. Background views are rated "outstanding" in all directions from the existing bridge site.

2. Visual Elements/Views

The preliminary roadway alignment used for the VPP inventory responds to earlier visual inventory findings regarding the sequential views of the travel experience approaching the existing Navajo Bridge. The following new visual elements were identified according to the preliminary design:

- Cuts
- Fills
- View of Colorado River
- View of Marble Canyon
- Headwalls and endwalls
- Guardrail
- Historic bridge
- Navajo commercial area
- New bridge
- Interpretive area/overlook
- Retaining walls
- Railing
- Restroom structure
- Parking
- Open view
- Enclosed view

The preliminary design results in the following loss of significant visual elements:

- Native vegetation
- Open view
- View of existing Navajo commercial area
- View of natural drainage
- Enclosed view
- View of historic structure at interpretive area
- Rock wall

These visual elements were located on the plan sheets within each unit (see figure B-30). The preliminary VPP quantifies the new visual elements and the loss of significant visual resources in the immediate foreground, foreground, middleground, and background zones, according to the preliminary roadway design.

Determine Values of Inventory Variables

For each of the new visual elements, for each numerical score, values were determined to inventory in the field and from the proposed plans. Values for each variable were determined in the field based on the characteristic landscape, the degree of variety, and the relative importance/proportion of new visual elements (see figure B-31).

Assumptions used for the VPP values on this project were made at this time. For example, the assumption was made to add different angles of view, visible from different distance zones, together. This assumption places an emphasis on the angle of view variable, which was appropriate for this characteristic landscape.

Setup Unit VPP Inventory Forms

The VPP inventory forms were developed for this project, with the visual elements identified for this project and the VPP variables included (see figures B-32 and B-33).

Perform Inventory

The proposed new visual elements and each significant visual element that would be lost were inventoried within each of the visual units, in terms of the variables listed, based on the preliminary cross sections, plans, and field reconnaissance. The application of VPP is demonstrated on this project in Unit H, where the natural rock wall at the historic structure is visible from the immediate foreground and foreground distance zones (see figure B-34).

New visual elements in Unit H include the view of the historic bridge and new bridge, view of the overlook, rock wall and ramada area (visible from Unit H), two fills (H1 and H2), and views of Marble Canyon and the Colorado River. Significant visual elements which will be lost include native vegetation within the construction limits. The inventory of new visual elements for Unit H is shown in figure B-32.

Two fills, H1 and H2, are located within this unit, and have a proposed size of 7,475 sq ft (694.4 sq m) and 31,000 sq ft (2,879.9 sq m). These fills, visible from the immediate foreground, foreground, and middleground views, are within the value range with a numerical score of 3 in the variable.

The H1 fill is visible peripherally from the new bridge from the foreground and immediate foreground distance zone, and is also visible from the river

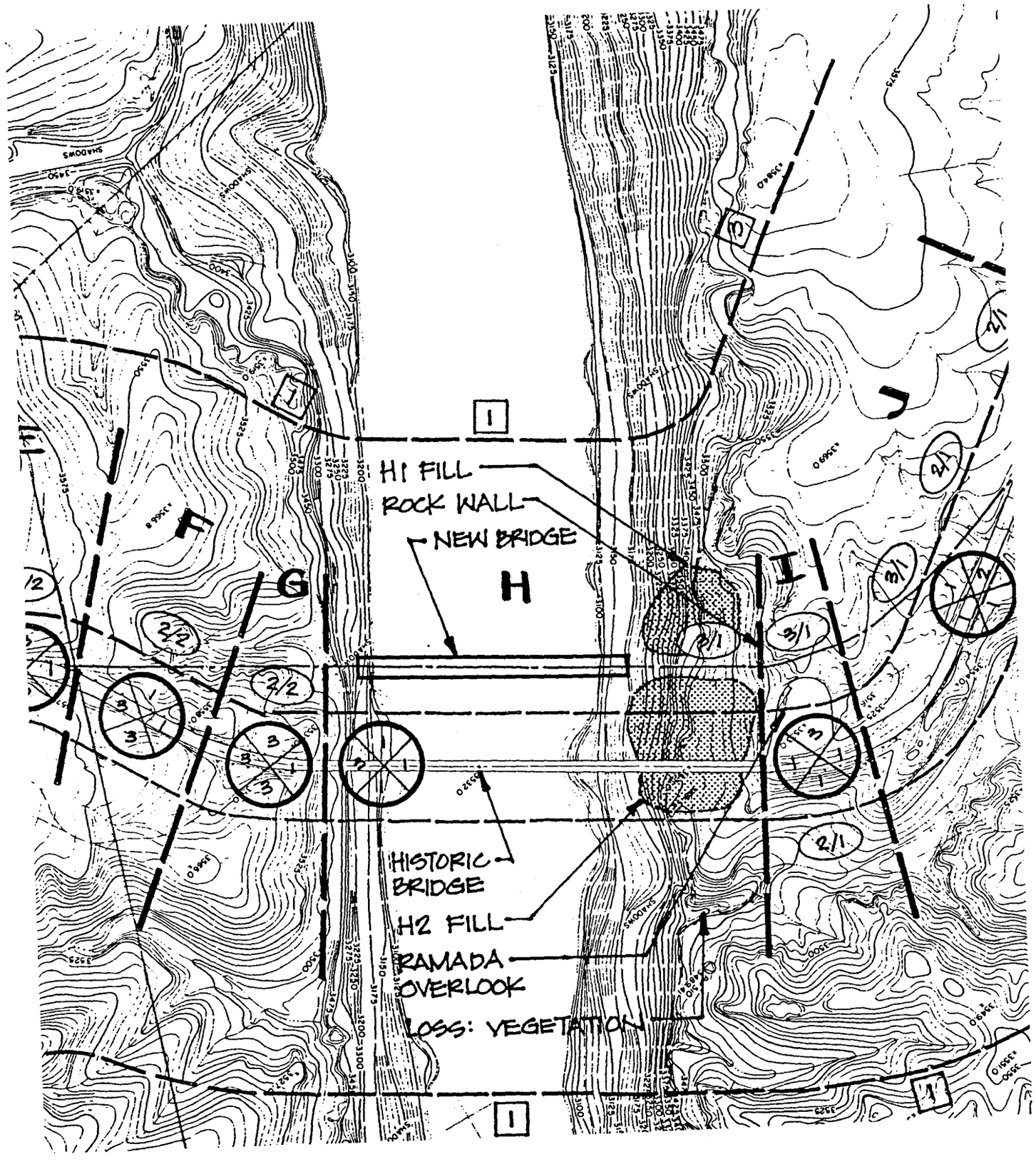


Figure B-30. Preliminary plan, new visual elements and loss of visual elements.

INVENTORY VARIABLES	NUMERICAL SCORE	
1) Distance from the viewer:	N/A	
Immediate foreground: 100' and less		
Foreground: 100' to 600'		
Middleground: 600' to 2.5 miles		
Background: 2.5 miles+		
2) Magnitude:		
Cuts and fills -		
0 - 600 sf	1	
600 - 4,000 sf	2	
4,000 sf+	3	
Headwalls, endwalls and retaining walls -		
0 - 999 sf	1	
1,000 - 1,999 sf	2	
2,000+ sf	3	
Guard rail and railing -		
0 - 199 lf	1	
200 - 499 lf	2	
500+ lf	3	
Bridges-		
0 -99 lf	1	
100 - 299 lf	2	
300+ lf	3	
Structures and parking area-		
small, sited to remain subordinate to characteristic landscape	1	
moderate size, visual element in characteristic landscape	2	
large, highly visible	3	
Views -		
relatively insignificant	1	
moderately significant	2	
significant	3	
3) Angle of the view:		
Horizontal-		
57.5 degrees - 180 degrees	1	
33 degrees - 57.5 degrees	2	
0 degrees - 33 degrees	3	
Vertical-		
0 degrees - 30 degrees	1	
30 degrees - 60 degrees	2	
60 degrees - 90 degrees	3	

Note: the assumption was made that, if more than one angle of view occurred, the variables would be added together.

4) Duration of the view/visibility*:

VIEWED FROM ROADWAY:	FROM DISTANCE ZONE:	
Immediate foreground		
0 - 3 seconds (less than or equal to 198')	1	BV*
3 - 6 seconds (198' - 396')	2	PV*
6+ seconds (396'+)	3	AV*
Foreground		
0 - 6 seconds (less than or equal to 396'	1	BV
6 - 10 seconds (396' - 660')	2	PV
10+ seconds (660'+)	3	AV
Middleground and background		
8 - 10 seconds (less than or equal to 660')	1	BV
10 - 20 seconds (660' - 1,320')	2	PV
20+ seconds (1,320'+)	3	AV

***Visibility ranking measures the equivalent of the duration of the view, when the element is viewed from a stationary location, and is defined as follows:**

BV - barely visible, indicating that the visual element is obscured or not an important visual element when viewed from this location
PV - partially visible, indicating that the visual element is partially obscured but is visible, and of average importance when viewed from this location
AV - always visible, and an important visual element when viewed from this location

Note: the assumption was made that, if more than one duration of view/visibility factor was involved, the most sensitive ranking was used.

5) Silhouette condition:	
no silhouette	0
background is vegetation/land	1
background is vegetation/land/sky combination	2
background is sky	3
6) Aspect:	
angles 0 to 30 degrees or 30 degrees away from viewer	1
angles 30 degrees to 60 degrees from viewer	2
perpendicular, nearly vertical (90 - 60 degrees)	3

Figure B-31. VPP inventory variables for Navajo Bridge.

NAVAJO BRIDGE

UNIT VPP INVENTORY-NEW VISUAL ELEMENTS

UNIT NO. H:3744+30-3752+58

STATION 820 LF

	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
CUTS																										
NONE																										
FILLS																										
H1 L 3751+80-3752+58	3	3	3		1	1	1						1	3	2		-	-	2		2	2	2		26	
H2 R 3751+80-3752+58	3	3	3		4	4	1						3	3	2		-	-	2		2	2	2		34	
																										60
WALLS, RAILING, GUARDRAIL																										
3752+58-3754+00	2	2	-		3	5	-						1	3	-		2	2	-		3	3	-		26	
																										26
BRIDGES																										
NEW 3744+30-3752+58	3	3	3		3	3	3						3	3	3		3	3	3		3	3	3		45	
OLD 3744+30-3752+58	3	3	3		3	3	3						3	3	3		3	3	3		3	3	3		45	
																										90
STRUCTURES																										
RAMADA/OVERLOOK/ROCK WALL	**4**	2			**5**	2							**3**	3			**1**	1			**3**	3			**27**	
																										27
																									UNIT TOTAL	**203**

Figure B-32. VPP inventory form, Navajo Bridge.

NAVAJO BRIDGE

UNIT VPP INVENTORY-LOSS OF SIGNIFICANT VISUAL RESOURCES

UNIT NO. H:3744+30-3752+58

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
VEGETATION																										
L 3744+30-3752+58	3	3			1	2							3	3			0	0			2	2			19	
R 3744+30-3752+58	2	2			2	3							3	3			0	0			2	2			19	
																										38
WALLS																										
STRUCTURES																										
ENCLOSED VIEW																										
OPEN VIEW																										
UNIT TOTAL																										38

Figure B-33. VPP inventory form, loss of significant visual resources.

Figure B-34. Proposed H2 fill area and wall in interpretive area, viewed from historic bridge.

(rafter's perspective) at a high vertical angle of view. The H2 fill is visible from these same angles, but is also in direct view from the interpretive area and historic, pedestrian bridge. These two scores 1 and 3 are added together for H2, according to an assumption made earlier in the inventory process. The result is a total of 4 for angle of view for the immediate foreground and foreground distance zones.

H2, a proposed fill, also provides a greater duration of view score due to its visibility from the interpretive area and historic, pedestrian bridge (see figure B-34). For this reason, H2 receives a higher overall score than H1, with 34 total points compared to 26. The total inventory for fills in Unit H is 60, combining H1 and H2 (see figure B-32).

The proposed wall in the interpretive area, at Station 3752+58 to 3754+00, is located in Unit I. The wall is visible from Unit H at the immediate foreground and foreground distance zones.

The magnitude of the wall is approximately 1,500 sq ft (139.4 sq m), and is scored 2 in *magnitude*. The angle of view is direct from the roadway traveling across the bridge, and is scored 3 in the immediate foreground. From the foreground view, the wall is visible directly, again while traveling across the bridge, and also at an angle from the historic, pedestrian bridge (see figure B-32). The two scores of 3 and 2 are added together for a total angle of view at the foreground distance zone of 5.

The *duration of view* is 2 seconds in the immediate foreground, scored 1 and always visible, and an important visual element, when viewed from the foreground, scored 3. The wall has a silhouette against vegetation/land/sky combined, and is scored 2 from both distance zones. Because it is proposed to be nearly vertical, the aspect is scored 3. The new wall scores for Unit H total 26.

Tally Total Value

The total inventory scores for each unit are compiled on a chart (see figure B-35). The visual elements are listed in order of their scores to determine the rating of the VPL's and logical cut-off points (see figure B-36). On the Navajo Bridge project, the cuts, fills, and bridge views were assigned VPL's of 1, 2, and 3. Fill

NAVAJO BRIDGE

UNIT TOTALS

UNIT	SPECIF AREA	CUT	VPL	FILL	VPL	WALLS	VPL	BRIDGE	VPL	NAV. COMM. AREA	VPL	STRUC-TURES	VPL	CUMMULATIVE UNIT TOTAL NEW	LOSS
A	1	21	3	19	3										
	2	25	3	24	2										
UNIT TOTAL		46		43										89	39
B	1	24	3	23	2										
	2	23	3	25	2										
UNIT TOTAL		47		48										95	67
C	1	29	2	19	3										
	2	22	3												
UNIT TOTAL		51		19										70	73
D	1	33	2	17	3										
	2	24	3	25	2										
	3	25	3	21	2										
UNIT TOTAL		82		63										145	105
E	1	38	1					24	3						
	2	38	1												
UNIT TOTAL		76						24						100	135
F	1	28	2	34	1			26	2	32	1				
	2	31	2												
UNIT TOTAL		59		34				26		32				151	117
G	1	32	2	30	1			23	3	32	1				
UNIT TOTAL		32		30				23		32				117	121
H	1			26		26		45				11			
	2			34				45							
UNIT TOTAL				60		26		90				11		**203**	38
I	1	28				43						[1] 23			
	2	34										[2] 25			
UNIT TOTAL		62				43						48		153	68
J	1	26		23											
	2	35		15											
UNIT TOTAL		61		38										99	46

[1] BATHROOMS

[2] OVERLOOK

Figure B-35. Tally total values.

H1 and H2, and the views of the new and historic bridges are designated as VPL 1 in Unit H.

Calculate Total and Net Visual Change

The total visual impacts, both new visual elements and losses, can then be compared by unit and by element within the units. The new elements and loss of visual elements within a unit can also be compared to see where the largest total impacts are. Unit H has the highest new visual element cumulative total on the project, at 203, and a total loss value of 38.

The next step involves identifying the visual sensitivity of the new and lost elements.

Field Check Preliminary Visual Priority Levels

At this point in the VPP process, it is important to field check the inventory data from a project-wide perspective. The extremes of each visual element (those rated highest and lowest) should be checked for accuracy. In addition, it is good to check the borderline visual elements which fall into the VPL's.

On this project, at the 60 percent complete review level, a member of the review team requested that the rating of the H1 fill, which was designated as a preliminary VPL 2, be checked for accuracy. Because the fill is continuous between H1 and H2, it was determined that the original designation of the H2 fill was extending into areas which were in fact visible from the interpretive area. The VPL 2 rating was adjusted in this case to a VPL 1, and the boundary of H2 was refined to accurately separate the area which was not visible from the interpretive site.

Design Mitigation Measures

The preliminary mitigation measures can be identified based on the visual goals of fitting new development into the existing characteristic landscape, compatibility of the historic/cultural elements, and replacement of the visual elements which have been identified as being lost in the development. For each new visual element and each lost visual element, mitigation measures are identified which reflect the form, line, color, and texture of the characteristic landscape, and are compatible with other resource goals on the project.

Develop Mitigation Plan

The VPP is applied in the design and recommended distribution of the mitigation measures throughout the project. Replacement of the lost resources will be according to natural systems and/or according to VPL, preferably within the same unit where the loss occurred.

Mitigation determined for the new visual elements on the Navajo Bridge project include the following:

- *Cuts and fills*—Detailed specialized grading and blasting techniques, rock placement in fill slopes, and revegetation to repeat the surrounding form, line, color, and texture found in the natural landscape. Quantities of detailed, bid items are distributed according to VPL.

- *View of Colorado River, view of Marble Canyon*—An open railing is proposed for the new bridge to protect views of the river and canyon, and also to provide views of the historic bridge. The open railing is patterned after the existing railing on the historic bridge. The interpretive area is being extended toward the river to provide safe, accessible visibility of the river and canyon.

- *Headwalls, endwalls, guardrail, retaining walls, railing*—Colored, patterned concrete is proposed for the headwalls and endwalls which have higher visual ratings. The guardrail is proposed to be a treated, non-reflective finish to lessen the visual impact. A stone masonry guardrail is being considered at the highest visual rating areas. High-ranked retaining walls are proposed to be faced or constructed with field stone. Handrails will be a combination of stone and steel railing.

- *Historic bridge*—The bridge will be maintained in its existing condition.

- *Navajo commercial area (Nav. comm. area)*—A location for commercial stands is being provided to be accessible by pedestrians, crossing the historic bridge, and by vehicles.

- *New bridge*—The new bridge, the largest new visual element in the area, is being designed to reflect the character of the historic bridge.

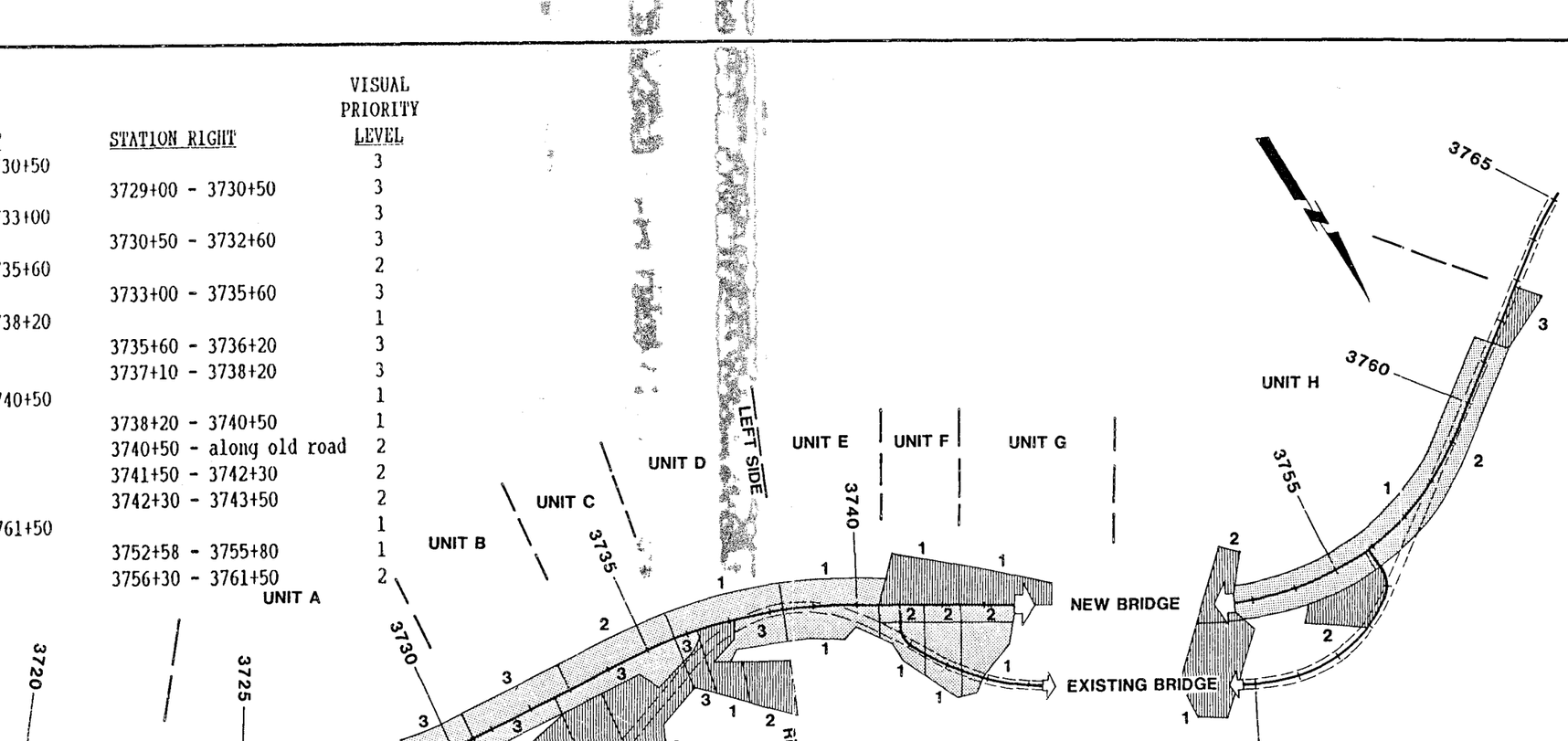
- *Interpretive area/overlook, restroom structure, parking*—Special detailing in these areas specifies structures built from native rock and wood, in scale with the existing, historic structures, which will be preserved in place.

- *Open view, enclosed view*—The approach roads were designed to meet new design speed criteria but continue to provide a gradual sequential viewing experience between the high plateau and the river/canyon crossing.

F.H.W.A. REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ				

STATION OF CUT

UNIT		STATION LEFT	STATION RIGHT	VISUAL PRIORITY LEVEL
A	1	3729+00 - 3730+50		3
	2		3729+00 - 3730+50	3
B	3	3730+50 - 3733+00		3
	4		3730+50 - 3732+60	3
C	5	3733+00 - 3735+60		2
	6		3733+00 - 3735+60	3
D	7	3735+60 - 3738+20		1
	8		3735+60 - 3736+20	3
	9		3737+10 - 3738+20	3
E	10	3738+20 - 3740+50		1
	11		3738+20 - 3740+50	1
F	12		3740+50 - along old road	2
	13		3741+50 - 3742+30	2
G	14		3742+30 - 3743+50	2
H	15	3752+58 - 3761+50		1
	16		3752+58 - 3755+80	1
	17		3756+30 - 3761+50	2



CUT AND FILL COMPOSITE PLAN

200 100 50 0 150 300

LEGEND

- CUT AREAS
- FILL AREAS
- 1,2,3 VISUAL PRIORITY LEVEL OF CUT AND FILL SLOPES
- 3720 STATION 3720+00

STATION OF FILL

UNIT		STATION LEFT	STATION RIGHT	VISUAL PRIORITY LEVEL
A	1	3723+00 - 3729+00		3
	2		3724+00 - 3729+00	2
B	3		3730+50 - 3732+60	2
	4		3732+60 - 3733+60	1
C	5		3733+00 - 3735+60	3
D	6		3735+60 - 3736+20	3
	7		3736+20 - 3737+10	1
	8		3737+10 - 3738+20	2
F	9	3740+50 - 3742+30		1
G	10	3742+30 - 3744+30		1
H	11	3751+80 - 3752+58		2
	12		3751+80 - 3752+58	1
	13		3754+00 - 3755+00	2
	14		3761+00 - 3762+50	3

	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION
DESIGN			
DRAWN			
CHECKED			
ROUTE	LOCATION		SHEET OF

TRACS NO

SURVEY NO | FINISHED PLANS | REVISIONS | LOCATION | DATE

Figure B-37. Cut and fill composite plan.

The loss of visual elements scores indicate where the greatest visual losses occur on the project. The list of mitigation measures is developed to mitigate loss and to detail the new elements so that they respond to the surrounding characteristic landscape.

The loss of native vegetation is one of the most significant visual elements that can be mitigated. Revegetation is proposed to be a combined effort involving seed collection, contract growing native plants, salvaging plants from the construction area for replanting, and seeding.

Other lost visual elements include existing, open views from the historic bridge and from under the historic bridge on the Park Service side, which will be blocked for safety reasons. These views will be replaced by new views offered from the new bridge, new pedestrian access on the historic bridge, and from the new overlook area. Other lost views, such as the view of the existing Navajo commercial area, view of the natural drainage, and the enclosed view while approaching the historic bridge, will be replaced by new views of the same or similar features.

The existing rock wall at the interpretive site is an important visual element to retain. Detailed blasting specifications are proposed to save this rock wall in place. If it is damaged during construction, the wall will be rebuilt using native rock.

Estimate Preliminary Mitigation Cost

The cost estimate for the 60 percent complete natural resource mitigation plans, distributed according to VPL's and inventory scores, was approximately $358,000, or 2.8 percent of the total construction cost. The project is over budget at this level, and methods are being considered to reduce the project costs.

Evaluate Overall Mitigation Plan

The final mitigation plans are being developed and adjusted according to concentrating the effective, and higher cost mitigation details to the VPL 1 areas, and other elements in units with high overall impact. The VPP is being used as a guide to direct mitigation measures while keeping the project on budget.

PHASE III—IMPLEMENTATION

Intermediate Design

During intermediate design, the alignment was shifted to attempt to save the rock structure in place, based on the preliminary VPP findings. At the 60 percent level, the new, large fill area, with a VPL 1 rating, is being detailed to have a natural-appearing character.

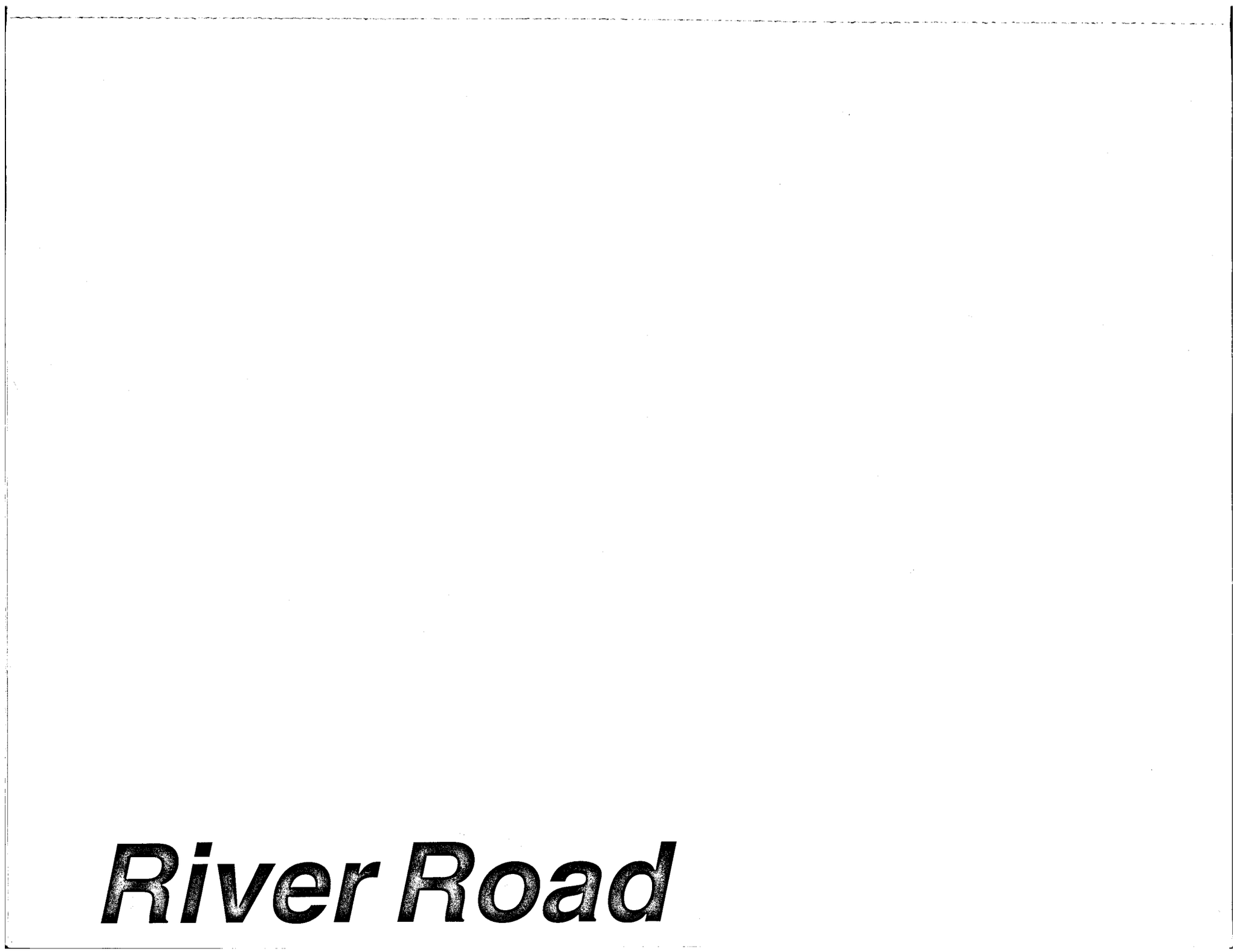
Final VPP Inventory/Final Design

The inventoried cuts and fills are highlighted on the Cut and Fill Composite Plan (see figure B-37). The plans include the inventoried VPL ratings of each new cut and fill along the highway, the mitigation measures, and mitigation quantities required for each VPL. By inclusion in the plans, the construction project manager and contractor will beaware of the visual quality objectives and priority levels during actual construction.

SUMMARY—EVALUATION OF COMPLETE VPP

By having unit totals for both the New Visual Elements and the Loss of Significant Visual Resources, it was possible to better gauge the total project impact, or Total Visual Change, in a given area. The "loss" total was extremely useful during the preliminary design phase, as the highway alignment could respond to avoid areas where resource loss was the greatest. Mitigation measures were identified to try to save or replace as much of a significant resource as possible.

Total Visual Change and Net Visual Change were not calculated for this project for all units due to time and budget constraints.


River Road

CASE STUDY NO. 3: RIVER ROAD

INTRODUCTION

The widening of five sections of River Road was authorized by a 1986 Pima County (Tucson, AZ) bond election. The segment of River Road between Fifteenth Avenue and First Avenue, 1.25 miles (2.01 km) is the first section of the roadway to be widened from its existing, two-lane configuration to a four-lane, divided roadway, with a design speed of 50 mph (80.5 km/h). Where possible, right-of-way is being purchased by Pima County at this time for the future widening of the roadway to six lanes. Major expenditures, such as bridges and culverts, will be designed to the six-lane width as part of this project.

This widening project also includes a linear park connection between River Road and the Rillito River Park, and improvements to the Oracle Road/River Road intersection. The study area is defined as the Rillito Creek/River Road area of influence around the project area. This area is bounded roughly by the Rillito Creek on the south, the foothill bluffs of the Catalina Mountains on the north, Fifteenth Avenue on the west, and First Avenue on the east. Portions of the study area are within the limits of the City of Tucson, and portions are under the jurisdiction of Pima County.

This application of the complete VPP extends to the final design stage.

PHASE I—EXISTING VISUAL RESOURCES

Character Zones

Many significant natural, cultural, and visual resources are located in the Rillito Creek/River Road area, which together define the area's character. Four "character zones" are defined along the entire Rillito Creek/River Road corridor: Historic Floodplain Influence Zone, Urban Influence Zone, Semi-rural/Agricultural Zone, and the Foothills Residential Zone (see figure B-38).

The River Road experience in the project area is marked by traveling at the edges of the Rillito River basin and the abrupt bluffs marking the foothills of the Santa Catalina Mountains. This study area is located within the Urban Influence Zone, Pima Wash to Camino Real Wash.

This section is characterized by mixed qualities and types of development, primarily commercial and multifamily residential. The topography is still relatively flat, due to the proximity of the Rillito Creek, however, the bluffs to the north become a prominent visual element. The bluffs extend to River Road in several locations, with exposed, eroded faces where River Road has encroached upon them (see figure B-39).

In addition to the bluffs, landmarks in this area include the Bates House, a two-story adobe, Rillito Downs racetrack, the University of Arizona Farms, Joesler buildings (unique architecture), Catalina Foothills School, St. Phillips Church, historic irrigation ditches, the "Pink Adobe," and other miscellaneous adobe residences. A historic route to the old Camp Grant, located north of the Catalina Mountains, crosses River Road just west of Oracle Road.

In this 1.25-mile (2.01 km) section, River Road begins to reflect the natural landform, and has a few curves in the existing alignment. This section contains the most congested traffic and has right-of-way constraints.

Visual Quality/Variety

The following definitions of visual quality were determined for River Road, according to the characteristic landscape:

- *Outstanding* visual quality/interest, unique features, and focal points of interest resulting in a high degree of visual variety with continuity, significant vegetation, good character of development, well maintained structures, good view (middleground), panoramic mountain view (background).

- *Typical* visual quality or interest, typical or average vegetation in fair or good condition, lack of definition of development, structures in average condition, average view (middleground), mountains visible but not outstanding (background).

- *Below Average/Incongruous* visual quality, disturbed land, incongruous development, poor condition and appearance of built and natural elements (middleground), mountains are not visible or are not a factor (background).

Visual Concern

Visual concern of adjacent landowners/managers was defined according to a combination of:

- Existing attention to visual quality demonstrated by landowner/manager
- Existing and proposed land uses
- Public participation.

Ratings were assigned as follows:

High—Landowners/managers have an above average concern for visual resources.

Average—Landowners/managers have an average concern for visual quality.

Low—Landowners/managers have a below average concern for visual quality.

Visual Goal

River Road is a designated scenic route in the City of Tucson and Pima County. The development of the roadway should respond to the setting which includes physiographic landmarks, topography, natural and cultural resources, and surrounding land use. A corridor-wide study, "Rillito Creek/River Road Design Process and Guidelines" (reference 9) was completed to identify resources and goals, and to direct future projects within the corridor.

Visual priorities adopted for this project are:

1. Protect and enhance variety in foreground visual resources which contribute to the character of the Santa Catalina foothills

   - protect and enhance significant native vegetation
   - rehabilitate disturbed areas
   - provide visual definition and views of washes
   - protect washes in the natural state
   - provide for wildlife movement along washes at roadway crossings
   - provide visual definition of major intersections.

2. Protect and enhance corridor and panoramic views of the Tucson Basin and surrounding mountains.

3. Provide a visual transition to developed areas along and at each end of the corridor.

The goals for view preservation and enhancement are summarized as follows:

- Preservation of natural mountain or open space vistas
- Elimination of obtrusive cut and fill slopes
- Preservation of desirable urban views
- Elimination of incongruous views.

PHASE II—VISUAL IMPACTS

Conceptual/Preliminary Design

The preliminary design is based on widening the roadway while minimizing impacts to resources and adjacent property owners, in a cost effective manner.

Because of the increased design speed of 50 mph (80.5 km/h), the existing curves and dips into washes are being lessened or eliminated in the roadway improvements.

Preliminary VPP Inventory

Conduct Detailed Visual Inventory

This study includes a visual inventory which defines existing visual quality and concern, opportunities for improving visual conditions along the route, potential visual impact, and mitigation treatments. The project area was inventoried according to a 55-degree peripheral angle of vision and a 1,400-ft (426.7 m) focusing distance, at the design speed of 50 mph (80.5 km/h).

1. Distance Zones

With the existing roadway centerline centered in the immediate foreground, distance zone widths determined for this project are (see figure B-40):

- *Immediate foreground*—Roadway right-of-way, approximately 150 ft (45.7 m) in width.

- *Foreground*—Area beyond immediate foreground, within the driver's "cone of vision" at the 50 mph (80.5 km/h) design speed, approximately 1,300 ft (396.2 m) in width.

- *Middleground*—Area beyond foreground, 5 mi (8.05 km) in width.

- *Background*—Visible area beyond the middleground.

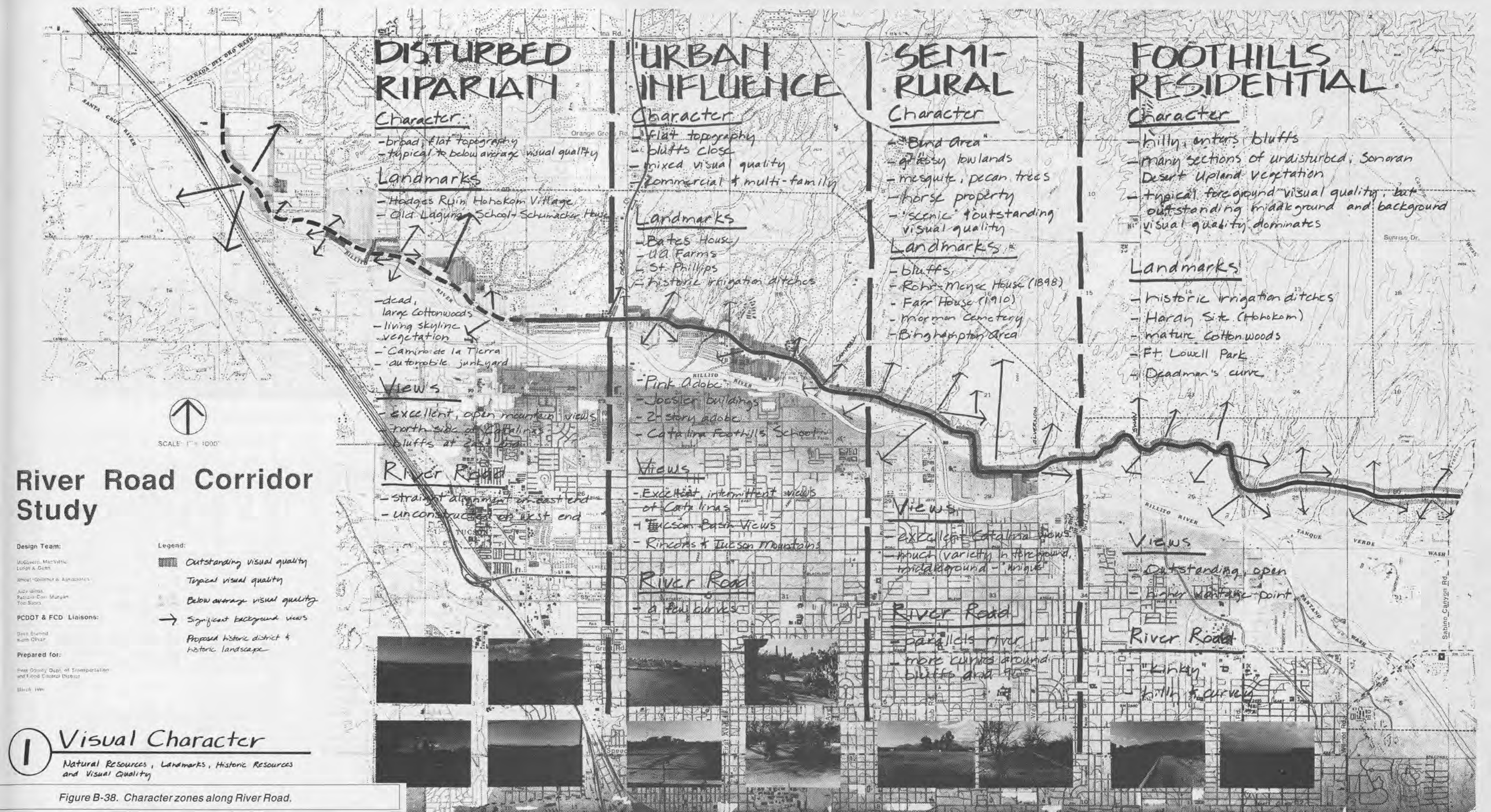


Figure B-38. Character zones along River Road.

Figure B-39. Existing curve adjacent to bluff along River Road.

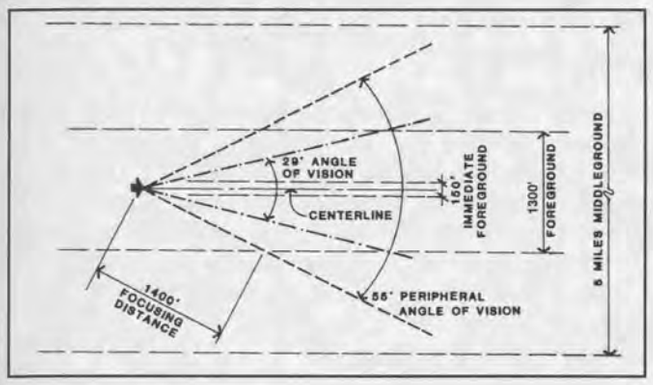


Figure B-40. Distance zones and angle of vision for River Road.

2. Visual Elements/Views

The following new visual elements were identified according to the preliminary design:

- Cuts
- Fills
- Headwalls and endwalls
- Guardrail
- Parking area
- View of new bridge
- View of drainages
- Bank stabilization
- Retention basin
- Open views
- Median
- New intersection
- Noise walls and sign walls
- Handrail
- Dike
- Equestrian trail

The preliminary design results in the following loss of significant visual elements:

- Native vegetation
- Introduced vegetation
- Sharp curves around bluffs
- View of natural drainage
- Enclosed view
- Walls

The preliminary VPP quantifies the new visual elements and loss of significant visual resources in the immediate foreground, foreground, middleground, and background zones, according to the preliminary roadway design.

3. Visual Units/Viewpoints

The corridor is divided into 14 visual units where changes in visual character and background views occur (see figure B-41). The two-part rating, for visual quality and visual concern, are assigned to the foreground and middleground areas (immediate foreground is addressed in the

VPP). Background views are also rated for visual quality, concentrating primarily on existing mountain vistas and significant urban view opportunities.

Following is a summary of the visual quality inventory for this character zone, comprised of 14 visual units (see figure B-41):

- Visual quality is outstanding, where native vegetation remains in place and quality development occurs; typical, and below average, where most of the development hasoccurred.

- Views of the Catalinas are also excellent in this section. Catalina views are intermittent and framed by structures,bluffs and sky line vegetation, which adds to the visual quality. Views are also available of the Tucson Basin (especially in the area of the new Stone Avenue intersection), the Rincon Mountains, and the Tucson Mountains.

- Visual concern in this section varies along the route, but is primarily average.

  Unit L, located between Oracle Road, on the west, and Old River Road, on the east, is described in greater detail for this case study. Land use in the unit includes residential (trailer park and single family homes) and commercial (service station, restaurant, and shopping center). The existing visual quality in Unit L rates "outstanding" {from the eastern boundary of the unit to the eastern edge of the commercial area at the corner of River Road and Oracle Road) due to native vegetation in good condition and development, which is in character with the area. The shopping center is rated low. The south side of River Road is rated typical at the trailer park and low at the service station at the corner of River Road and Oracle Road. Visual concern is average throughout the unit on adjacent land and high for the roadway traveler. Background views are typical to the west, east and north, and low to the south.

Determine Values of Inventory Variables

The inventory rating levels of each criteria used on this project (see figure B-42) has been presented. Ratings for each variable were determined in the field based on the characteristic landscape, the degree of variety, and the relative importance/ proportion of new or lost visual elements.

Each proposed new visual element and each significant visual element that would be lost were inventoried for the above conditions, based on the preliminary cross sections, plans, and field reconnaissance.

Setup Unit VPP Inventory Forms

The VPP inventory forms were developed for this project with the visual elements identified and the VPP variables included (see figures 43 and 44).

Perform Inventory

The proposed new visual elements and each significant visual element that would be lost were inventoried within each of the visual units, in terms of the variables listed, based on the preliminary cross sections, plans, and field reconnaissance. The application of VPP is demonstrated on this project by examining both selected scores of the new and lost visual elements, and also mitigation measures for selected elements in Unit L (see figure B-43).

Proposed new visual elements in the unit include two fills, four noise walls, handrail and concrete drainage inlet, new median, and a new view to the southeast due to a new curve in the realignment of the roadway (see figure B-44).

The inventory of significant visual resources which will be lost include native vegetation, introduced vegetation, and an enclosed view (due to the removal of introduced vegetation) (see figure B-45). These visual elements were inventoried for their magnitude only.

These elements were inventoried according to the criteria defined for this project. The total of new visual element scores for Unit L is 198. The total of loss of significant visual elements for the unit is 65 (see figures 44 and 45). Total Visual Change and Net Visual Change were not calculated for this project due to time and budget constraints.

Tally Total Value

The total inventory scores for each unit were compiled for the project.

Calculate Total and Net Visual Change

The total visual impacts, both new visual elements and losses, were then compared by unit and by element within the units.

Field Check Preliminary Visual Priority Levels

The proposed noise walls in Unit L, with a total score of 78, rated high and was determined to be a VPL 1 wall. The VPL's were checked in the field, during the preliminary design phase, to ensure appropri-

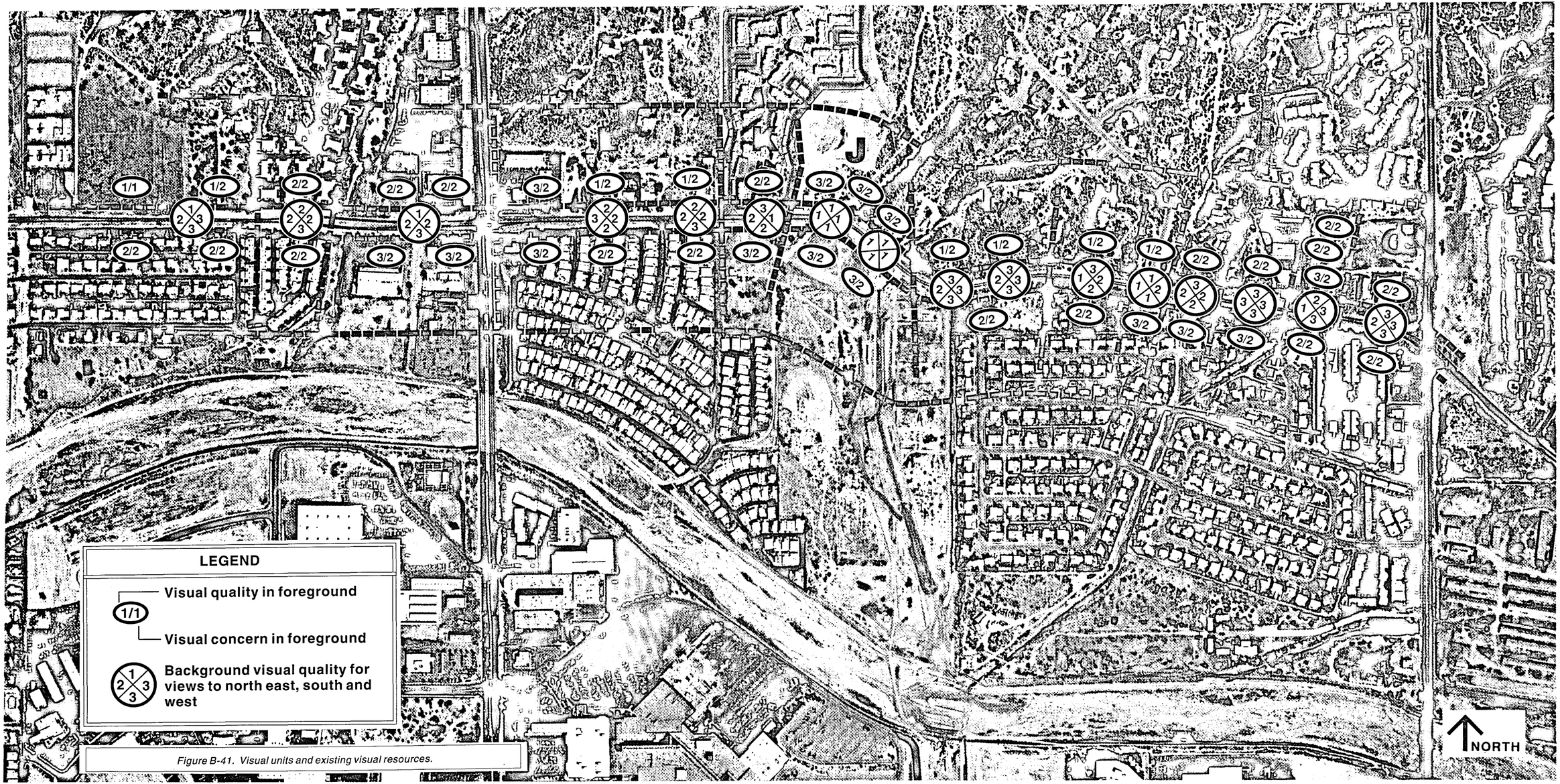


Figure B-41. Visual units and existing visual resources.

River Road: 15th Ave. to 1st Ave.
Planning and Design Report

Wheat-Gallaher & Associates
Landscape Architecture – Resource Planning – Urban Design
377 South Meyer Avenue, Tucson, Arizona 85701 (602) 884-7911

McGovern/MacVittie/Lodge & Deamline
ENGINEERING
PLANNING
SURVEYING
3505 N. Campbell Avenue, Suite 101 Tucson, AZ 85719
(602) 326-3996 • FAX (602) 326-9863

INVENTORY VARIABLES	NUMERICAL SCORE	
1) Distance from the viewer:	N/A	
Immediate foreground: 75' and less		
Foreground: 75' to 660'		
Middleground: 660' to 2.5 miles		
Background: 2.5 miles+		
Note: the distance zones are set up as measured from centerline.		
2) Magnitude:		
Cuts, fills, bank grading, bank protection, dikes and swales:		
0 - 499 sf	1	
500 - 1,499 sf	2	
1,500 sf+	3	
Walls:		
0 - 999 sf	1	
1,000 - 1,999 sf	2	
2,000 sf+	3	
Equestrian trail:		
0 - 499 lf	1	
500 - 999 lf	2	
1,000 lf+	3	
Intersections:		
secondary access 'T'	1	
primary access 'T'	2	
4-way intersection	3	
Median:		
wide (20')	1	
narrow, less than 300 lf	2	
narrow, greater than 300 lf	3	
Guardrail, handrail:		
0 - 199 lf	1	
200 - 499 lf	2	
500 lf+	3	
Bridges:		
0 - 2,499 sf	1	
2,500 - 9,999 sf	2	
10,000 sf+	3	
Views:		
minimally significant views of typical resources	1	
average view of typical resources	2	
significant view of characteristic landscape	3	
3) Angle of the view:		
Horizontal:		
55 degrees - 180 degrees	1	
29 degrees - 55 degrees	2	
0 degrees - 29 degrees	3	
Vertical:		
0 to 30 degrees	1	
30 to 60 degrees	2	
60 to 90 degrees	3	
4) Duration of the view/visibility*:		
VIEWED FROM ROADWAY:		**FROM DISTANCE ZONE:**
Immediate foreground		
0 - 3 seconds (less than or equal to 220')	1	BV*
3 - 6 seconds (220' - 440')	2	PV*
6+ seconds (440'+)	3	AV*
Foreground		
0 - 6 seconds (less than or equal to 440')	1	BV
6 - 10 seconds (440' - 733')	2	PV
10+ seconds (733'+)	3	AV
Middleground and background		
8 - 10 seconds (586' to 733')	1	BV
10 - 20 seconds (733' - 1,466')	2	PV
20+ seconds (1,466'+)	3	AV

***Visibility ranking measures the equivalent of the duration of the view, when the element is viewed from a stationary location, and is defined as follows:**

BV - barely visible, indicating that the visual element is obscured or not an important visual element when viewed from this location
PV - partially visible, indicating that the visual element is partially obscured but is visible, and of average importance or is codominant with other elements when viewed from this location
AV - always visible, and an important or dominant visual element when viewed from this location

5) Silhouette condition:	
no silhouette	0
background is vegetation/land	1
background is vegetation/land/sky combination	2
background is sky	3
6) Aspect:	
faces directly away from viewer	1
angles indirectly away from or toward viewer	2
faces viewer directly	3

Figure B-42. VPP inventory variables for River Road.

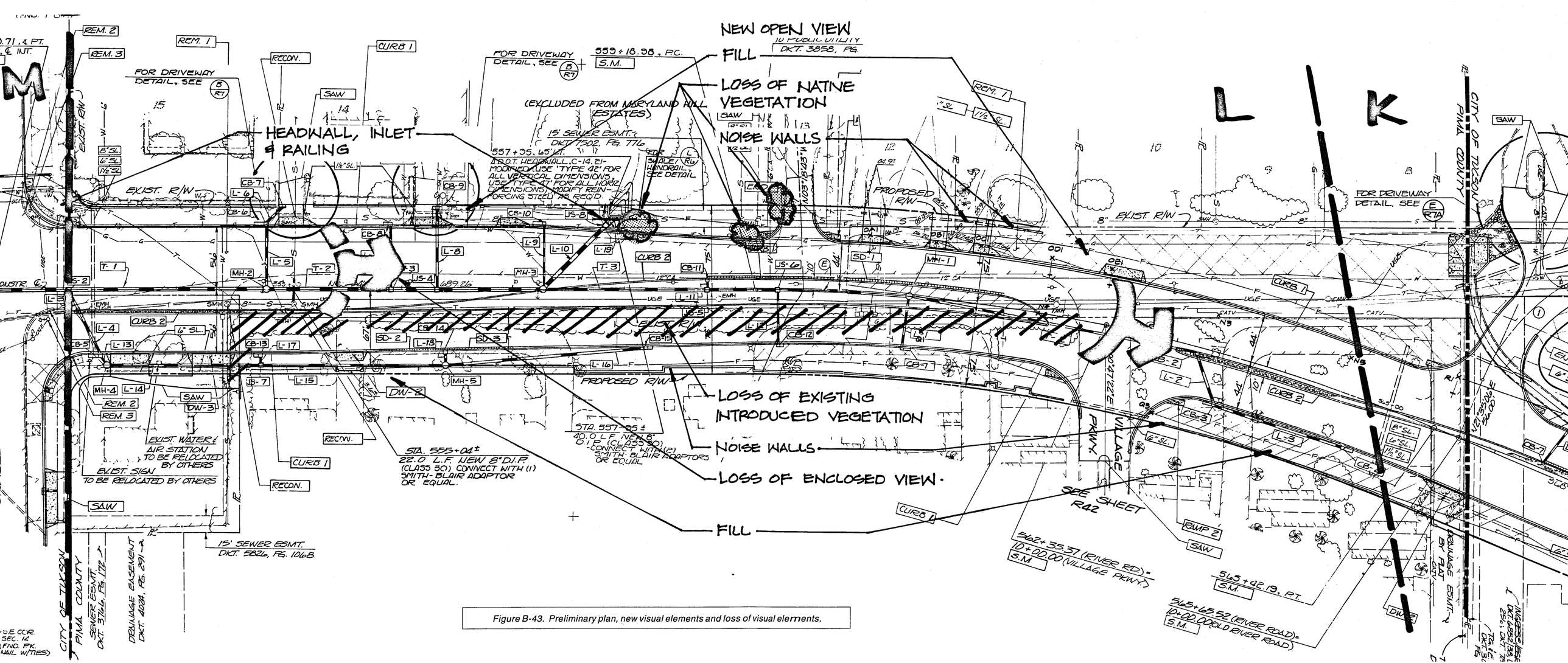

NEW OPEN VIEW
FILL
LOSS OF NATIVE VEGETATION
NOISE WALLS
LOSS OF EXISTING INTRODUCED VEGETATION
NOISE WALLS
LOSS OF ENCLOSED VIEW
FILL
HEADWALL, INLET & RAILING
FOR DRIVEWAY DETAIL, SEE
559+18.98, P.C.
S.M.
(EXCLUDED FROM MARYLAND HILL ESTATES)
15' SEWER ESMT. DKT. 7502, PG. 776
557+05.65' LT.
N.S.O.T. HEADWALL, C-14.21- MODIFIED USE "TYPE 42" FOR ALL VERTICAL DIMENSIONS, USE "TYPE 47" FOR ALL HORIZ. DIMENSIONS, MODIFY REINFORCING STEEL AS REQ'D.
FOR 3'WIDE (R/L) HANDRAIL SEE DETAIL
PROPOSED R/W
EXIST. R/W
PROPOSED R/W
STA. 555+04± 22.0 L.F. NEW 8" D.I.P. (CLASS 50) CONNECT WITH (1) SMITH-BLAIR ADAPTOR OR EQUAL.
STA. 557+85± 40.0 L.F. NEW 8" D.I.P. (CLASS 50) CONNECT WITH (2) SMITH-BLAIR ADAPTORS OR EQUAL
EXIST. WATER & AIR STATION TO BE RELOCATED BY OTHERS
EXIST. SIGN TO BE RELOCATED BY OTHERS
15' SEWER ESMT. DKT. 5821, PG. 106B
CITY OF TUCSON PIMA COUNTY
SEWER ESMT. DKT. 3764, PG. 102
DRAINAGE EASEMENT DKT. 4021, PG. 291
CITY OF TUCSON PIMA COUNTY
8" EXIST. R/W
FOR DRIVEWAY DETAIL, SEE
DRAINAGE ESMT. BY PLAT
SEE SHEET R42
562+35.37 (RIVER RD.)= 10+00.00 (VILLAGE PKWY.) S.M.
563+92.19, P.T. S.M.
565+63.52 (RIVER ROAD)= 10+00.00 OLD RIVER ROAD
VILLAGE PKWY.
RAMP 2
CURB 1
CURB 2
SAW
RECON.
REM. 1
REM. 2
REM. 3
L
K
M

Figure B-43. Preliminary plan, new visual elements and loss of visual elements.

RIVER ROAD

UNIT VPP INVENTORY-NEW VISUAL ELEMENTS

UNIT NO. L : 553+00 - 565+00

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
MEDIAN																										
553+00 - 565+00	3	3			1	2							1	2							1	1			14	14
FILLS																										
L 553+00 - 565+00	3	3			3	3							3	3							3	3			24	
R 553+00 - 565+00	3	3			3	3							3	3							3	3			24	48
WALLS																										
R 554+55 - 562+10	3	3			2	2							3	3			1	1			2	2			22	
R 563+02 - 565+00	2	2			2	2							3	3			1	1			2	2			20	
L 560+90 - 561+05	1	1			2	2							3	3			1	1			2	2			18	
L 561+28 - 561+67	1	1			2	2							3	3			1	1			2	2			18	78
VIEWS																										
OPEN 560+00 - 565+50	2	2			3	2							3	2							3	3			20	20
CONCRETE DRAINAGE INLET, HEADWALL																										
L 557+50 - 557+90	2	2			3	2							3	3							2	2			19	
																										19
HANDRAIL																										
L 557+50 - 557+90	1	1			3	2							3	3			1	1			2	2			19	
																										19
																									UNIT TOTAL	198

Figure B-44. River Road VPP form—New Visual Elements.

RIVER ROAD

UNIT VPP INVENTORY-LOSS OF SIGNIFICANT VISUAL RESOURCES

UNIT NO. L: 553+00-565+50

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
VEGETATION																										
L INTRODUCED	1	1			3	2							1	1			1	1			2	2			15	
R INTRODUCED	2	2			3	2							2	2			1	1			2	2			19	
L NATIVE	1	1			3	2							1	1			1	1			2	2			15	49
WALLS																										
STRUCTURES																										
ENCLOSED VIEW																										
554+50-565+00	2	2			2	2							2	2							2	2			16	
																										16
OPEN VIEW																										
																									UNIT TOTAL	65

Figure B-45. River Road VPP form—Lost Visual Elements.

ateness. During the field review, a notation was made to indicate visual elements which were continuous between units to evaluate their magnitude scores.

Design Mitigation Measures

Mitigation measures for all new visual elements and lost elements were developed to respond to and reinforce the character of River Road, the visual goals for the project, and the existing visual quality and concern ratings.

The preliminary mitigation measures for the noise walls included identifying significant walls and materials along River Road which contribute to the character of the area, and the walls within the project area which will be lost due to the roadway construction (see Units H and N). Preliminary design ideas were developed to construct the new noise walls with adobe block, similar to the wall which will be partially removed in Unit H (see figure B-46), and simulated adobe block, similar to the wall which will be removed and replaced in Unit N. These mitigation measures, in addition to revegetation plans, were developed according to the most significant resources lost during construction. In addition, several details were developed to add interest and variety to areas where long stretches of noise wall are required, such as in Unit L (see figures 47 and 48).

Develop Mitigation Plans

The details which were developed to add variety to the proposed noise walls were distributed according to the VPL's of the new walls throughout the project. In addition to the details shown, the wall was stepped in and out in areas to increase variety.

In Unit L, a VPL 1 wall, a gate, two adobe buttresses, a pot wall detail, and three niches were detailed (see figure B-49). In addition, both wall materials (the stucco and exposed adobe) were used, and the wall stepped in and out in two locations. This treatment illustrated the highest level of noise wall mitigation in the project.

SUMMARY— EVALUATION OF COMPLETE VPP

The VPP inventory was utilized on the River Road project to distribute mitigation design throughout the roadway project according to where the largest combined visual impacts were occurring. With the use of the VPP, both the proposed new visual impacts and the loss of significant visual resources were addressed.

The VPP process was used to design mitigation measures by identifying the significant visual resources which would be lost, in an effort to replace these resources. This mitigation included the wall example shown as well as native vegetation along the route (see figure B-46).

Figure B-46. Significant visual element which will be lost during construction.

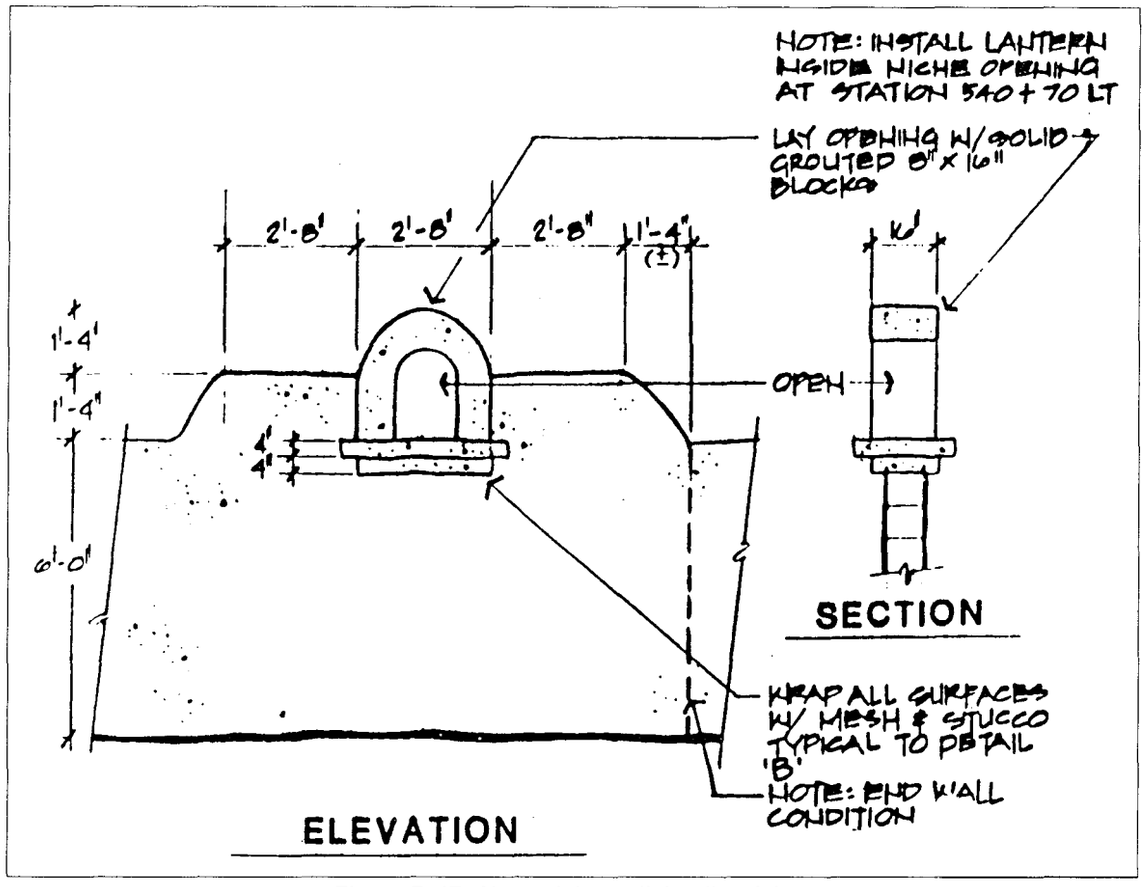


Figure B-47. New adobe wall detail—niche.

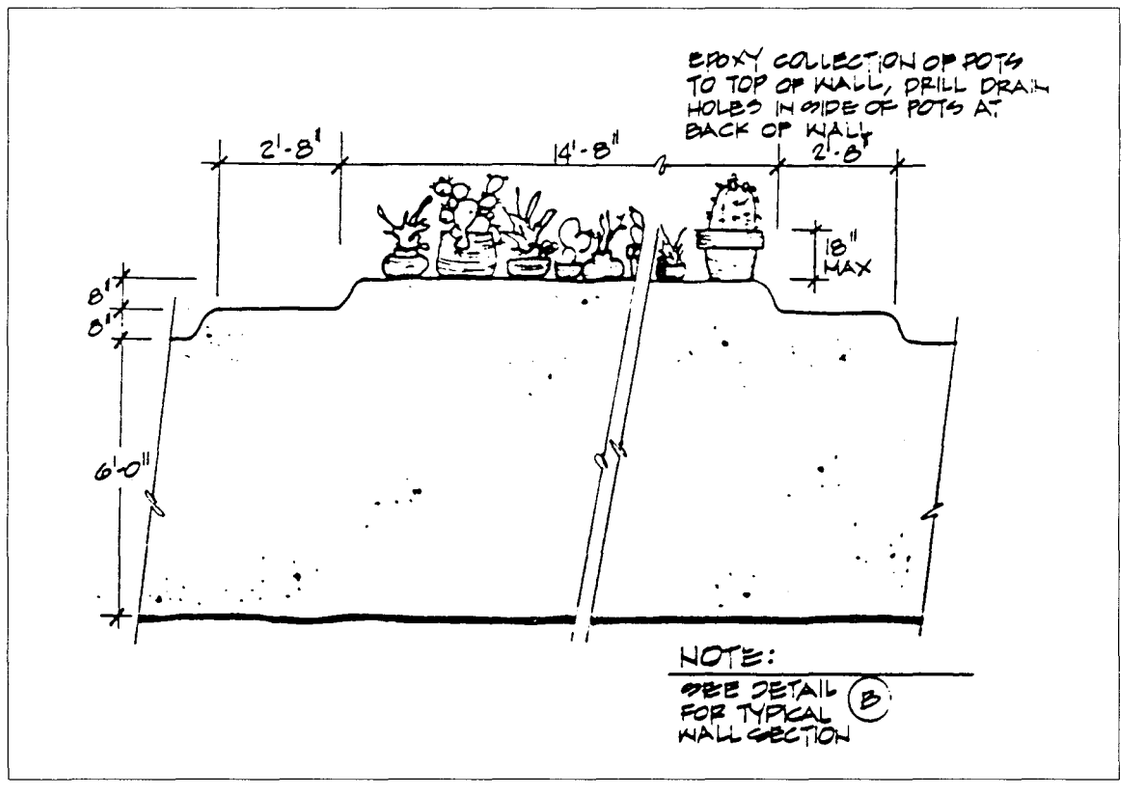


Figure B-48. New stucco wall detail—pot wall.

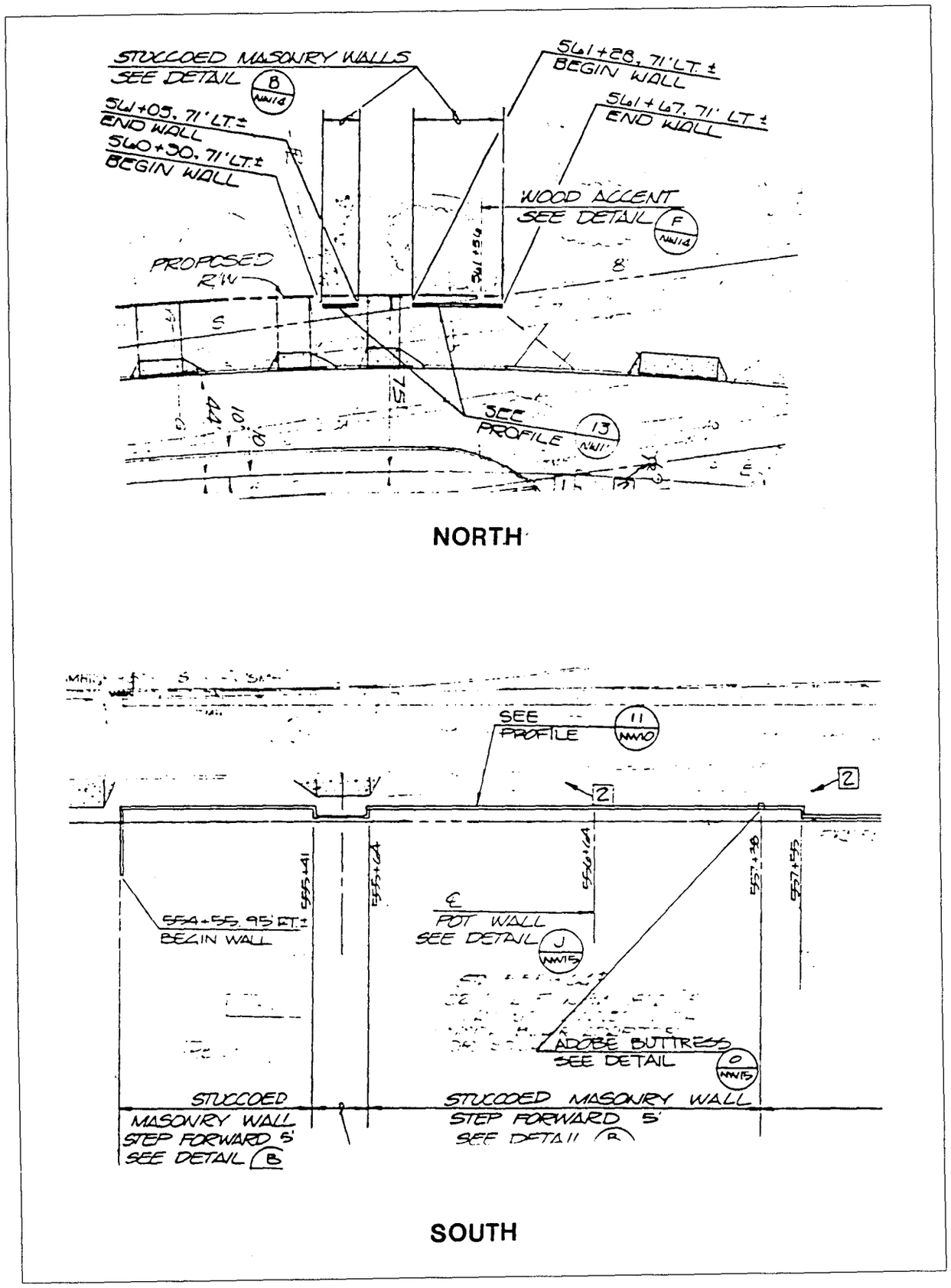


Figure B-49. Unit L noise wall plan.

The VPP process also indicated which of the new visual elements were the most highly visible. This enabled the mitigation measures to concentrate on the most visibly sensitive elements. For example, concrete headwalls and endwalls of new culverts were treated with colored and textured concrete, with increased screen plantings, in areas of high visibility. Where these elements were a low VPL, untreated concrete was specified.

Additional mitigation, which was not included in the inventory process, included placing an existing overhead power line underground. This measure improved the visual quality along the corridor by removing an existing negative visual element.

Natchez Trace Pkwy

Natchez Trace Pkwy

CASE STUDY NO.4: NATCHEZ TRACE PARKWAY

INTRODUCTION

The Natchez Trace Parkway is a roadway within the National Park System which, upon completion, will stretch from Nashville, Tennessee, to Natchez, Mississippi. The Parkway follows the prehistoric and historic routes of the Natchez, Chickasaw, and Choctaw Indians, French and Spanish settlers, and Americans. Nearly 445 mi (716.5 km) long, the Natchez Trace began as Indian trails and grew into a national road and communications link between the lower Mississippi Valley to the Union in the early 1800's. Conserved sections of the historic route, known as the "Old Trace," are located adjacent to the Parkway in several locations and available for hiking and interpretation.

Construction began in the late 1930's, and is expected to be complete in 1997. Over 80 percent of the 445-mi (716.5 km) Parkway has been completed, with three sections remaining: The northernmost link near Nashville, the section near Jackson, Mississippi, and the southernmost portion, which will terminate at Natchez, Mississippi.

Natchez Trace Parkway is a scenic route. The National Park Service obtained a wide right-of-way for the development and management of the Parkway. Visual, natural, and cultural resources along the route are managed by the National Park Service, both in-house and by contract, sometimes with adjacent land owners. The posted speed limit varies along the route, but never exceeds 50 mph (80.5 km/h).

This study demonstrates the use of VPP during the location phase of preliminary design on a 3.4-mi (5.47 km) section of the Parkway near Jackson, Mississippi. The VPP process was applied on a 6,000-ft (1,829 m) section of the new alignment where two alternatives are being considered.

PHASE I—EXISTING VISUAL RESOURCES

Character Zone

The section of Natchez Trace Parkway in the Jackson, Mississippi area is characterized by gently rolling topography, mixtures of deciduous and coniferous tree cover, open meadows and clearings for agriculture, periodic views of drainages, ponds and lakes, and primarily rural land uses with fringe urbanization as the roadway nears Jackson (see figure B-50).

Figure B-50. Characteristic landscape of Natchez Trace near Jackson.

Forested areas include broad-leaf deciduous and needle-leaf evergreen trees, such as loblolly pine, short-leaf pine, oak, hickory, sweetgum, blackgum, red maple, and elm. The main grasses are bluestem, panicums, and long-leaf uniola. Dogwood, viburnum, blueberry, American beauty-berry, youpon, and numerous woody vines are common. Views along the route vary between forested enclosures and open meadows, ponds, lakes, rural structures, and residences.

Visual Quality/Variety

Variety of the existing landscape was defined according to the conditions found within the characteristic landscape, as follows:

- *Outstanding*—High degree of variety within the defining natural resource visual elements (primarily vegetation and water), structures reflect the rural character or historic periods in the area, vegetation is in good condition, visual cohesiveness, interesting mixture of enclosed and open views due to variety in the vegetation, introduced elements respond to the natural and cultural resources of the area, and are well maintained, interrupted and intriguing views into the distance are partially obscured by vegetation, views of unique features and focal points of interest.

- *Typical*—Average amount of variety within the defining natural resource visual elements, vegetation is in average condition, structures and introduced elements are generally in character with the surrounding area and are in average condition, views have some variety in degree of openness and enclosures.

- *Below Average/Incongruous*—Monotonous visual elements or excessive amounts of elements with no cohesiveness, natural features have been disturbed, vegetation is in poor or declining condition, structures and introduced elements do not relate to the character of the area and/or are not well maintained, little or no variety in form, line, color, or texture of the topography and vegetation.

Visual Concern

Visual concern is twofold: Concern for the visual quality of visitors traveling along the route and those adjacent to and within viewing distance of the route.

Visual concern of adjacent landowners/managers was defined according to a combination of:

- Existing attention to visual quality demonstrated by landowner/manager.
- Existing and proposed land uses.
- Public participation.

Ratings were assigned as follows:

High—Landowners/managers have an above average concern for visual resources.

Average—Landowners/managers have an average concern for visual quality.

Low—Landowners/managers have a below average concern for visual quality.

The Visual Concern, or concern of roadway travelers for visual quality, was determined to be high. A relatively high percentage of Parkway users have a strong interest in visual quality and scenery.

Visual Goals

The visual resource goal for the Natchez Trace project is to preserve the rural character of the area, while providing the traveler an opportunity to pass through the area at an "unhurried" pace and view scenic resources (see figure B-51). The road and structural-related elements of the Parkway are visually minimized along the route. For example, the shoulder is constructed of a gravel subbase and topped with soil/gravel mix and seeded, resulting in a grass-covered, visually unobtrusive shoulder. Other special details, such as bridge abutments, have been designed to reflect the character of the area.

The Natchez Trace Parkway ranges from 500 ft (152.4 m) to 1,250 ft (381.0 m) in width. This enables the National Park Service to manage and protect the land use and visual quality in the immediate foreground. Specific visual objectives include protecting and offering views of outstanding visual elements visible from the roadway, integrating new design elements and mitigating construction activities so that, immediately following construction, the new design elements will compliment the characteristic landscape. Disturbed areas will then blend into the natural landscape and will not be evident. This visual goal is equivalent to the Retention Visual Quality Objective of the Forest Service. When alternative views are available, preference is given to offering rural, as opposed to urban, views from the roadway.

PHASE II - VISUAL IMPACTS

Conceptual/Preliminary Design

The FHWA has prepared a preliminary location alignment of a 3.4-mi (5.47 km) section of roadway for review. This section includes alternatives for

Figure B-51. View of future Natchez Trace Parkway at project location.

crossing the existing Old Agency Road at-grade or on an elevated bridge. The Natchez Trace Parkway is a limited access facility, which requires alternative local access routes.

Both alternatives can be designed to meet the visual goals for the project. The bridge alternative is more costly than the at-grade alternative; however, cost alone is not the deciding issue in the final alternative selection. Because the right-of-way is bordered by a multitude of private landowners and the area has a history of use and access, visual resource concerns are a significant issue in the evaluation of alternatives. Both alternatives have local access solutions proposed. The description of the alternatives follows.

Alternative 1: Natchez Trace crossing Old Agency Road at-grade

This alternative requires a 762.0 m (2500-ft) section of Old Agency Road to be abandoned as a roadway, and renovated for pedestrians, as an Old Trace interpretive area (see figure B-52). The closure of a section of Old Agency Road requires a new local access road, "Old Agency Junior," running parallel to the Natchez Trace Parkway to the south. This roadway would provide access to residences at the southwest part of the study area, the Dinsmor subdivision, and the Greenwood Plantation.

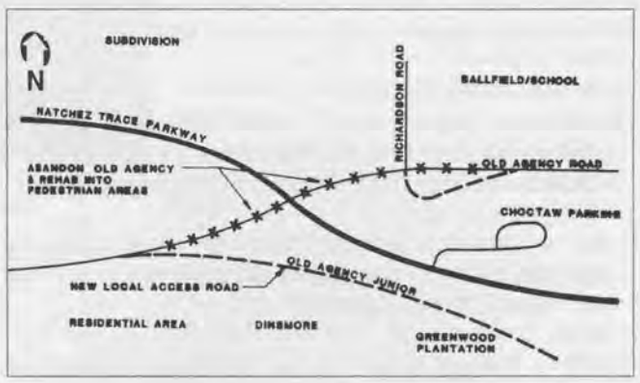


Figure B-52. At-grade alternative.

In addition, Old Agency Road would be slightly realigned on the north side of Natchez Trace to connect with the existing Richardson Road. A newly constructed section of County Road B is proposed to provide additional local access on the north side of the Parkway (not shown).

Alternative 2: Natchez Trace crossing Old Agency Road on a bridge

This alternative does not alter the current alignment of Old Agency Road, with Natchez Trace Parkway crossing on an elevated bridge (see figure B-53). Local access is altered in one location on the south side of the Parkway, on the east end, where a new section of Old Agency Junior is proposed to connect with Brame Road. In addition, a new driveway is extended to the Greenwood Plantation.

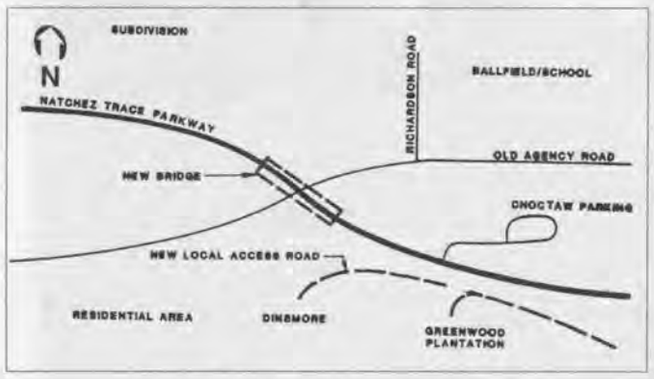


Figure B-53. Bridge alternative.

Preliminary VPP Inventory

Conduct Detailed Visual Inventory

This study includes a visual inventory for the 6,000-ft (1,828.7 m) section of the new Parkway where alternative alignments are being evaluated. The visual inventory defines existing visual quality and concern along the route. The project area was inventoried according to a 45-deg peripheral angle of vision and a 1,800-ft (548.6 m) focusing distance, at the design speed of 60 mph (96.6 km/h).

1. Distance Zones

With the existing roadway centerline centered in the immediate foreground, distance zone widths determined for this project are (see figure B-54):

- *Immediate foreground*—Area immediately adjacent to the roadway, approximately 150 ft (45.72 m) in width.
- *Foreground*—Area beyond immediate foreground, within the driver's "cone of vision" at the 60 mph (96.6 km/h) design speed, approximately 1,600 ft (490 m) in width.
- *Middleground*—Area beyond foreground, 5 mi (8.05 km) in width.
- *Background*—Visible area beyond the middleground.

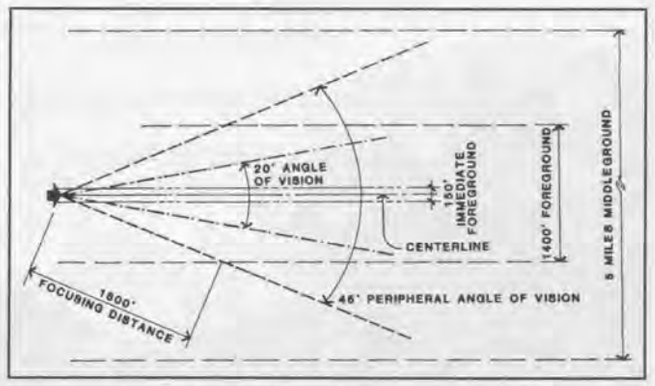


Figure B-54. Distance zones and angle of vision for Natchez Trace.

Following is a summary of the visual quality inventory for this section of the Natchez Trace Parkway:

- Visual resources along this section of the Natchez Trace Parkway are outstanding in forested areas on the west end, north of the Dinsmor subdivision, and in the central portion, south of the ball field and west of Brame Road. Another area of outstanding visual quality is the tree-canopied, narrow, Old Agency Road, especially along the section near the ball field. This section of existing roadway is a strong character-defining resource in the area. Other areas of outstanding visual quality include the Greenwood Plantation house south of the right-of-way (somewhat of a landmark in the area), and two grassy openings, one near the intersection of Old Agency Road and the proposed Natchez Trace Parkway, and one east of Brame Road, which includes a pond and small stands of trees (see figure B-55).
- Areas of average visual quality include the remaining residential areas adjacent to the right-of-way, the ball field and school located north of Old Agency Road on the east end of the study area, and a grassy clearing located west of the Dinsmor entry road.
- Areas of below average visual quality are located in weedy, unkept fields north of Dinsmor and north of the intersection of Old Agency Road and the proposed Natchez Trace Parkway.

2. Visual Elements/Views

The following new, significant visual elements were identified according to the preliminary design:

- Cuts
- Fills
- Enclosed views
- Structures

Figure 55. Potential view of Greenwood Plantation adds to character of area.

- Bridge
- Pedestrian area
- Open views
- Adjacent development
- Parking area
- Local access roads

The preliminary design results in the following loss of significant visual elements:

- Forested areas
- Tree canopy along Old Agency Road
- Clearings, fields, and meadows
- Enclosed views down narrow drives
- Enclosed view on Old Agency Road.

The preliminary VPP quantifies the new visual elements and loss of significant visual resources in the immediate foreground, foreground, middleground, and background zones, according to the preliminary roadway design.

Determine Values of Inventory Variables

The inventory value ranges of each variable used on this project is shown in figure B-56. Values for each variable were determined in the field based on the characteristic landscape, the degree of variety, and the relative importance/ proportion of new or lost visual elements. Each proposed new visual element and each significant visual element that would be lost were inventoried for the above conditions, based on the preliminary cross sections, plans, and field reconnaissance.

Setup Unit VPP Inventory Forms

The VPP inventory forms were developed with the visual elements identified and the VPP variables included (see figures B-57 through B-60).

The proposed, new visual elements and each significant visual element that would be lost were inventoried in the 6,000-ft (1,828.7 m) section, from Station 820+00 to 880+00 of the proposed Parkway, where the alternative alignments are developed. The inventory focused on the variables listed, and was based on the preliminary cross sections, plans, and field reconnaissance.

The VPP inventory includes the assessment of the visual impacts of the new Parkway and associated access roads from nine areas adjacent to and within the right-of-way in this area. It also includes impacts viewed from the proposed

INVENTORY VARIABLES	NUMERICAL SCORE	
1) Distance from the viewer:	N/A	
Immediate foreground: 75' and less		
Foreground: 75' to 800'		
Middleground: 800' to 2.5 miles		
Background: 2.5 miles+		
Note: the distance zones are set up as measured from centerline.		
2) Magnitude:		
Cuts and fills:		
0 - 2,499 sf	1	
2,500 - 7,499 sf	2	
7,500 sf+	3	
Pedestrian area:		
0 - 499 lf	1	
500 - 999 lf	2	
1,000 lf+	3	
Bridges (plan view or elevation):		
0 - 2,499 sf	1	
2,500 - 9,999 sf	2	
10,000 sf+	3	
New Views:		
minimally significant views	1	
view with some significance, average degree of change	2	
significant view, noticeable change from existing	3	
Structures, adjacent development and parking areas:		
minimally significant	1	
some significance	2	
visually significant	3	
3) Angle of the view:		
Horizontal:		
45 degrees - 180 degrees	1	
20 degrees - 45 degrees	2	
0 degrees - 20 degrees	3	
Vertical:		
0 to 30 degrees	1	
30 to 60 degrees	2	
60 to 90 degrees	3	
4) Duration of the view/visibility*:		
VIEWED FROM ROADWAY:		**FROM DISTANCE ZONE:**
Immediate foreground		
0 - 3 seconds (less than or equal to 264')	1	BV*
3 - 6 seconds (264' - 528')	2	PV*
6+ seconds (528'+)	3	AV*
Foreground		
0 - 6 seconds (less than or equal to 528')	1	BV
6 - 10 seconds (528' - 880')	2	PV
10+ seconds (880'+)	3	AV
Middleground and background		
8 - 10 seconds (704' to 880')	1	BV
10 - 20 seconds (880' - 1,760')	2	PV
20+ seconds (1,760'+)	3	AV

***Visibility ranking measures the equivalent of the duration of the view, when the element is viewed from a stationary location, and is defined as follows:**

BV - barely visible, indicating that the visual element is obscured or not an important visual element when viewed from this location
PV - partially visible, indicating that the visual element is partially obscured but is visible, and of average importance or is codominant with other elements when viewed from this location
AV - always visible, and an important or dominant visual element when viewed from this location

5) Silhouette condition:	
no silhouette	0
background is vegetation/land	1
background is vegetation/land/sky combination	2
background is sky	3
6) Aspect:	
faces directly away from viewer	1
angles indirectly away from or toward viewer	2
faces viewer directly	3

Figure B-56. VPP inventory variables for Natchez Trace Parkway.

NATCHEZ TRACE

UNIT VPP INVENTORY-NEW VISUAL ELEMENTS

ALTERNATIVE NO. 1 - AT-GRADE

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
CUTS																										
b: from I	3	3			3	2							2	1			1	1			2	1			19	
b: from NT	3	3			2	2							3	2			1	1			3	2			22	
b: from C	3	2			3	2							3	3			1	1			1	1			20	
e: from NT	2	2			2	2							3	1			1	1			3	2			19	80
FILLS																										
a: from NT	2	2			1	2							3	1							1	1			13	
c: from NT	1	1			1	2							3	1							1	1			11	
c: from H		1				3								1								3			8	
c: from I	1	1			3	2							2	1								3			13	
d: from NT	2	2			2	1							3	1							1	1			13	
d: from H		2				3								2								3			10	
d: from I		2				2								2								3			9	77
VIEWS																										
a: from NT	2	1			2	2							3	1							2	2			15	
b: from NT	1	1			2	2							2	1							3	3			15	
c: from NT	1	1			2	2							2	1							2	1			12	
d: from NT	2	2			2	2							2	1							2	1			14	
e: from NT	1	1			2	2							2	1							3	3			15	71
STRUCTURES/ADJACENT DEVELOPMENT																										
F: from NT		1				2								1								1			5	
F: from E		1				2								2								1			6	
E: from NT		1				2								1								1			5	
E: of NT		2				2								2								1			7	
B: from NT		2				1								1								3			7	
B: of NT		2				1								1								2			6	
A: from NT		2				2								2								2			8	
A: of NT		2				3								2								1			8	
A: of I		1				2								1								2			6	
A: from I		1				2								1								3			7	
H: from NT		2				2								2								3			9	
H: of NT		2				3								2								1			8	
H: of I		1				1								1								1			4	
H: from I		1				2								1								3			7	
G: of NT		2				2								2								1			7	
G: from NT		2				2								2								3			9	
C: from NT		2				2								2								3			9	
C: of NT		2				3								2								1			8	
G: of I		1				2								2								1			6	
G: from I		2				2								2								3			9	141
ADJACENT ACCESS																										
I: from NT	1	1			2	2							1	1								1			9	
I: of NT	2	2			3	2							2	2								1			14	
☐AR: from NT	1	2			2	2							1	2							1	1			12	
F: from ☐AR		1				2								1								1			5	
☐ARJr.: from D		2				3								3							1	1			10	
☐ARJr.: from I		2				2								3								1			8	
☐ARJr.: from NT		2				2								3								1			8	
☐ARJr.: from B		2				3								2								1			8	
☐ARJr.: from A		2				3								3								1			9	
☐ARJr.: from H		2				3								3								1			9	
RICH: from G		2				2								1								1			6	
RICH: from I	2	2			3	3							2	1							1	1			15	113

UNIT TOTAL 482

Figure B-57. Natchez Trace VPP form—New Visual Elements (Alternative 1—At-Grade).

NATCHEZ TRACE

UNIT VPP INVENTORY-NEW VISUAL ELEMENTS

ALTERNATIVE NO. 2 - BRIDGE

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
CUTS																										
b: from NT	2	2			2	2							2	1			1	1			3	2			18	
e: from NT	3	3			2	2							3	2			1	1			3	2			22	
b: from C	2	1			3	2							3	2			1	1			1	1			17	57
FILLS																										
a: from NT	2	2			2	1							3	1							1	1			13	
c: from NT	1	1			2	2							3	1							1	1			12	
c: from C		1				3								2			1	1				3			11	
d: from NT	3	3			2	1							3	1							1	1			15	
d: from H		3				3								3								2			11	
d: from OAR	3				2									2			1				1				9	71
VIEWS																										
a: from NT	2	2			2	2							2	1							2	2			15	
b: from NT	2	2			2	1							2	1							2	1			13	
c: from NT	3	3			2	2							2	1							2	1			16	
d: from NT	2	2			3	3							2	1							2	1			16	
e: from NT	1	1			2	2							2	1							1	1			11	71
BRIDGES																										
from: NT	1	1			2	2							2	1			1	1			1	1			13	
from: A		2				3								1				1				2			9	
from: G		2				3								1				1				2			9	
from: C		3				3								3				1				2			12	43
STRUCTURES/ADJACENT DEVELOPMENT																										
F: from NT		1				2								1								1			5	
F: from E		1				2								1								1			5	
F: from OAR		1				2								1								1			5	
F: from NT		1				2								1								1			5	
E: from NT		1				2								1								1			5	
E: of NT		2				2								1								1			6	
B: from NT		3				1								1								3			8	
B: of NT		2				3								1								1			7	
A: from NT		2				2								2								2			8	
A: of NT		2				3								3								1			9	
H: from NT		2				2								2								3			9	
H: of NT		2				3								3								1			9	
G: of NT		2				2								2								1			7	
G: from NT		2				2								2								3			9	
C: from NT		2				2								2								3			9	
C: of NT		2				3								3								1			9	110
ADJACENT ACCESS																										
OAR: from NT	2	2			2	2							1	2							1	1			13	
OAR: of bridge	3	3			3	2							2	2			2	2			3	3			25	
OAR: of d	3	3			2	2							3	3							3	3			22	
ADJACENT ACCESS (continued)																										
OAR: of C	1	1			2	2							2	2							3	3			16	
OAJr.: from NT		1				2								1								1			5	
OAJr.: from B		1				3								1								1			6	87

NATCHEZ · TRACE

UNIT VPP INVENTORY-LOSS OF SIGNIFICANT VISUAL RESOURCES

ALTERNATIVE NO. 1 - AT-GRADE

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
VEGETATION																										
FORESTED AREAS	2	3			2	1							1	1			2	2			3	3			20	
TREE CANOPY	3	3			2	2							3	3			2	2			3	3			26	
																										46
ENCLOSED VIEW																										
OLD AGENCY ROAD	3	3			2	2							3	3							3	3			22	
NARROW DRIVES	2				1								1				2				3				9	
																										31
CLEARINGS																										
OPEN MEADOWS	2				2								3								1				8	
WEEDY FIELDS	2				2								3								1				8	
																										16
																									UNIT TOTAL	93

ALTERNATIVE 1
TOTAL: NEW POSITIVE VISUAL ELEMENTS - 177
TOTAL: NEW NEGATIVE VISUAL ELEMENTS - 305
TOTAL: NEW POSITIVE ELEMENTS LOST - 85
TOTAL: NEW NEGATIVE ELEMENTS LOST - 8

TOTAL VISUAL CHANGE = 575

NET VISUAL CHANGE = -205

Figure B-59. Natchez Trace VPP form—Lost Visual Elements (Alternative No. 1—At-grade)

NATCHEZ TRACE

UNIT VPP INVENTORY-LOSS OF SIGNIFICANT VISUAL RESOURCES

ALTERNATIVE NO. 2 - BRIDGE

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
VEGETATION																										
FORESTED AREAS	1	2			2	1							1	1			2	2			3	3			18	
TREE CANOPY	1	1			2	1							1	1			2	2			3	3			17	
																										35
ENCLOSED VIEW																										
NARROW DRIVES	2				1								1								3				7	
																										7
CLEARINGS																										
OPEN MEADOWS	2				2								3								1				8	
WEEDY FIELDS	2				2								3								1				8	
																										16
																									UNIT TOTAL	58

ALTERNATIVE 2
TOTAL: NEW POSITIVE ELEMENTS - 147
TOTAL: NEW NEGATIVE ELEMENTS - 292
TOTAL: EXISTING POSITIVE ELEMENTS LOST - 50
TOTAL: EXISTING NEGATIVE ELEMENTS LOST - 8

TOTAL VISUAL CHANGE = 497

NET VISUAL CHANGE = -187

Figure B-60. Natchez Trace VPP form—Lost Visual Elements (Alternative No. 2—Bridge)

Figure B-61. Typical view of Natchez Trace Parkway from adjacent road as an example of new visual impact.

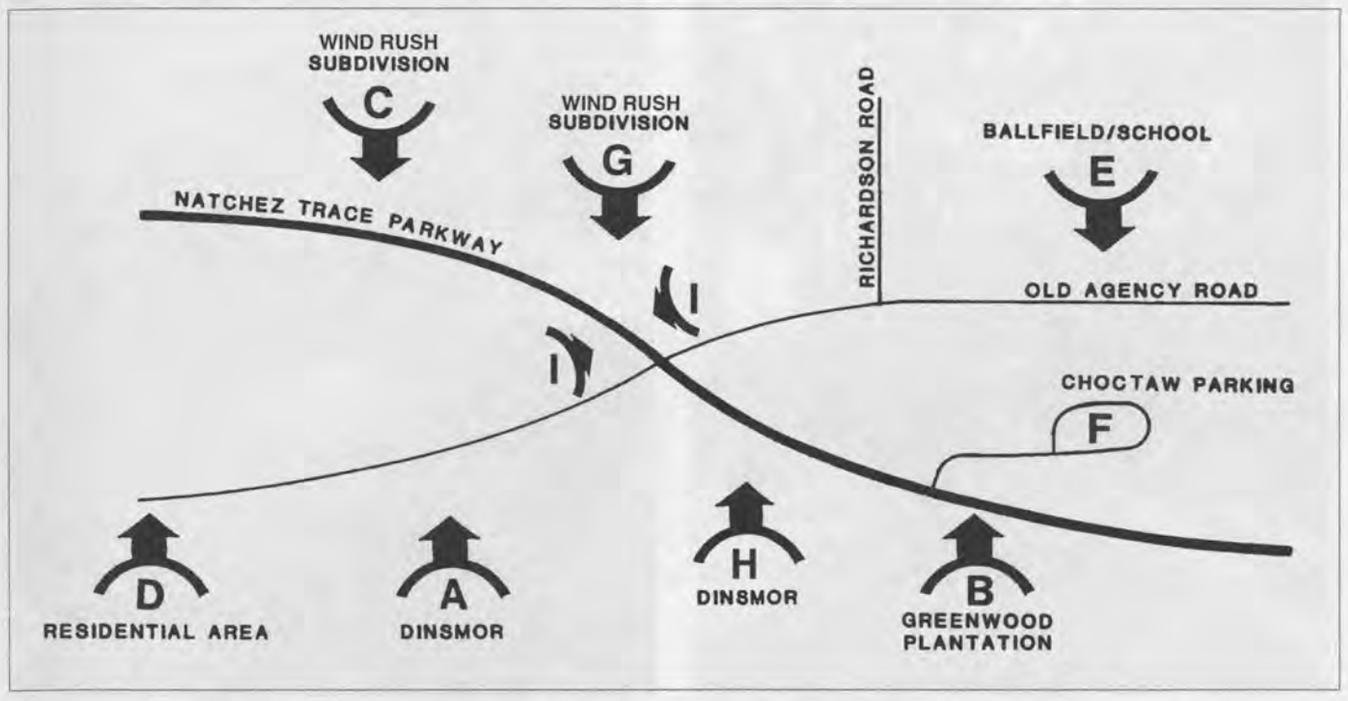


Figure B-62. Viewpoints selected for visual impact assessment adjacent to the roadway corridor.

Natchez Trace Parkway (see figure B-61). The areas selected for impact assessment include: Dinsmor subdivision (A and H), Greenwood Plantation (B), Wind Rush subdivision (C and G), residences south of the right-of-way (D), the ball field/school area (E), Old Agency Road at the Natchez Trace crossing area (I), and the Choctaw parking area (F) (see figure B-62).

These areas are within the foreground distance zone of the Parkway. Views from the Natchez Trace Parkway and from the Old Agency Road crossing area (I) occur in both the immediate foreground and foreground distance zones. By including ratings from these selected areas, the VPP inventory addresses a combination of concerns of the traveler and the adjacent property owners.

The application of VPP is demonstrated on this project by examining:

1. The scores of the new and lost visual elements for the alternatives:
   - New visual elements which are detrimental to the characteristic landscape, without mitigation.
   - New visual elements which are neutral or supportive of the characteristic landscape without mitigation.
   - Existing significant positive and neutral visua elements which will be lost.
   - Existing negative visual elements which will be lost.
2. The use of the VPP process in the selection of alternatives during the planning phase of the design process.

Proposed new visual elements in the area under Alternative 1 include two cuts, three fills, new open and enclosed views, a new pedestrian area to be interpreted as "Old Trace", and views of adjacent structures, development, proposed Choctaw parking area, and new local access roads.

Proposed new visual elements in the area under Alternative 2 include the above elements, except instead of the "Old Trace" to be developed at-grade, this alternative includes a bridge.

The inventory of significant visual resources which will be lost, inventoried for both alternatives, include

Figure B-63. Significant resource which will be lost in Alternative 1 to the proposed Natchez Trace Parkway.

forested areas, enclosed views down narrow driveways, and open meadows. A significant visual resource which would be lost under Alternative 1 includes a section of historic tree canopy along Old Agency Road and an enclosed view in that location (due to the removal of the tree canopy) (see figure B-63).

The VPP inventory scores of Fill 'd' are described below to demonstrate the inventory process on this project. Fill 'd' extends from Station 848+00 to 854+00, with a maximum height of 8 ft (2.4 m), and an approximate square footage of 2,700 sq ft (250.8 sq m) in Alternative 1 (see figure B-64). Fill 'd' is significantly larger in Alternative 2, extending from Station 845+00 to 854+00 at a maximum height of 28 ft (8.53 m), with an approximate square footage of 18,000 sq ft (1,672.2 sq m) (see figure B-65). The fill is in the value range with a numerical score of 3 for the magnitude variable in Alternative 2, and a 2 for magnitude in Alternative 1, when viewed from the Natchez Trace (NT).

The fill is visible from Natchez Trace Parkway, in the immediate foreground and foreground distance zones, and from the Dinsmor subdivision (H), in the foreground distance zone, in both alternatives. In alternative 1, the fill is also visible from the proposed "Old Trace" pedestrian/interpretive area(s) (I) in the foreground distance zone. In Alternative 2, the fill is visible from Old Agency Road (OAR) in the immediate foreground distance zone.

The angle of view scores for Fill 'd' are as follows: In Alternative 1 and 2, the angle of view from Natchez Trace in the immediate foreground and foreground distance zones are 2 and 1 respectively. The angle of view from the Old Trace in Alternative 1 is 2, direct. The angle of view from Dinsmor is 3, direct.

In Alternative 2, the angle of view from the Old Agency Road is 2. The angle of view from Dinsmor is 3, direct. The duration of view/visibility scores vary. In both alternatives, the duration of view/ visibility is 3 from the immediate foreground at Natchez Trace, as the fills are in view for more than 6 sec at 60 mph (96.6 km/h) and a 1 from the foreground view from Natchez Trace. In Alternative 1, the fill receives a 2 when viewed from the Old Trace, because of the viewing time of pedestrians. The fill receives a 2 from Dinsmor, because the new access road which would be between Dinsmor and the fill would somewhat reduce the visibility of this new fill associated with Natchez Trace.

In Alternative 2, the fill receives a 2 when viewed from Old Agency Road because of the existing trees which would largely screen the view of the fill from the vehicles traveling on that road. The actual *duration of view* from Old Agency Road is estimated to be 4 sec. The fill receives a 3 when viewed from Dinsmor because of its high visibility. Computer enhanced photos, figures B-66 through B-72, show the existing views and the two alternatives viewed from the Dinsmor subdivision (location A) and from the Old Agency Road (location B). These images are helpful in assessing accurate scores for the various elements in each alternative.

The total fill scores are 77 for Alternative 1, and 71 for Alternative 2, indicating that the total visual impact of fills is greater in the at-grade alternative than in the bridge alternative, even though the fill at the actual structure is a larger impact in Alternative 2.

Tally Total Values

The scores for the other visual elements were tallied for the unit. After the alternative is selected, the scores for each element can be used to determine VPL's. Each of the categories of new visual elements are totaled for the alternatives below:

	Alternative 1	**Alternative 2**
Cuts	80	57
Fills	77	71
Views	71	71
Adjacent access roads	113	87
Bridge	0	43
Adjacent development	141	110
Total	482	439

The inventory of significant visual resources which will be lost, inventoried for both alternatives, resulted in the following:

	Alternative 1	**Alternative 2**
Vegetation	46	35
Enclosed views	31	7
Clearings	16	16
Total	93	58

Total and Net Visual Change

By adding the above visual elements at their positive/neutral or negative values, the Total Visual Change and Net Visual Change for each alternative can be calculated:

	Alternative 1	Alternative 2
a. Total negative visual elements	305	292
b. Total neutral, positive visual elements	177	147
c. Total positive elements lost	85	50
d. Total negative elements lost	8	8
Total Visual Change (TVC)	575	497
Net Visual Change (NVC)	-205	-187

The formula for TVC is: **a + b + c + d**
(305 + 177 + 85 + 8 = 575 for Alternative 1 and
292 + 147 + 50 + 8 = 497 for Alternative 2).

The formula for NVC is : **b + d - a - c**
(177 + 8 - 305 - 85 = -205 for Alternative 1 and
147 + 8 - 292 - 50 = -187 for Alternative 2).

The Total Visual Change indicates that Alternative 1 will have the biggest total impact on the project area, while the Net Visual Change indicates that this alternative also has the largest, overall negative visual impact in the area. While these calculations address the impacts which would result directly from these two alternatives, the local jurisdiction can utilize the information generated by the VPP.

The identification of significant visual resources in the area, for example, can be addressed as additional projects are proposed.

Field Check Preliminary Visual Priority Levels

After the preliminary inventory scores and alternative evaluation findings are completed, each score was checked in the field, from the viewing location, to insure appropriateness and accuracy. On this project, a much more detailed inventory was developed between the preliminary and final inventory stage.

SUMMARY—USE OF VPP IN ALTERNATIVE ANALYSIS

The TVC and NVC can be used as input for weighing visual resources in the alternative selection process, along with other resource, safety, and economic considerations involved. After the alternative has been selected, the visual element scores can be used to direct mitigation needs.

The total impact scores for fills is larger in Alternative 1, even though the largest fill, required at the bridge in Alternative 2 (from Station 845 to 854), is significantly larger than the fill required in Alternative 1. The total impact of associated access roads is also higher in Alternative 1, due to the closing of Old Agency Road and the construction of a new roadway to the south of Natchez Trace.

The summary of visual analysis factors is useful in comparing the total visual impacts of the two alternatives. The VPP process shows the context of each visual concern, for example, a view from one adjacent property when combined with the other significant visual issues. These findings can now be used in conjunction with comparing costs, local transportation impacts, and other factors associated in choosing the best alternative for this section of the Natchez Trace. When the alternative has been selected, the VPP findings can be used to design mitigation along the roadway to minimize the visual impacts.

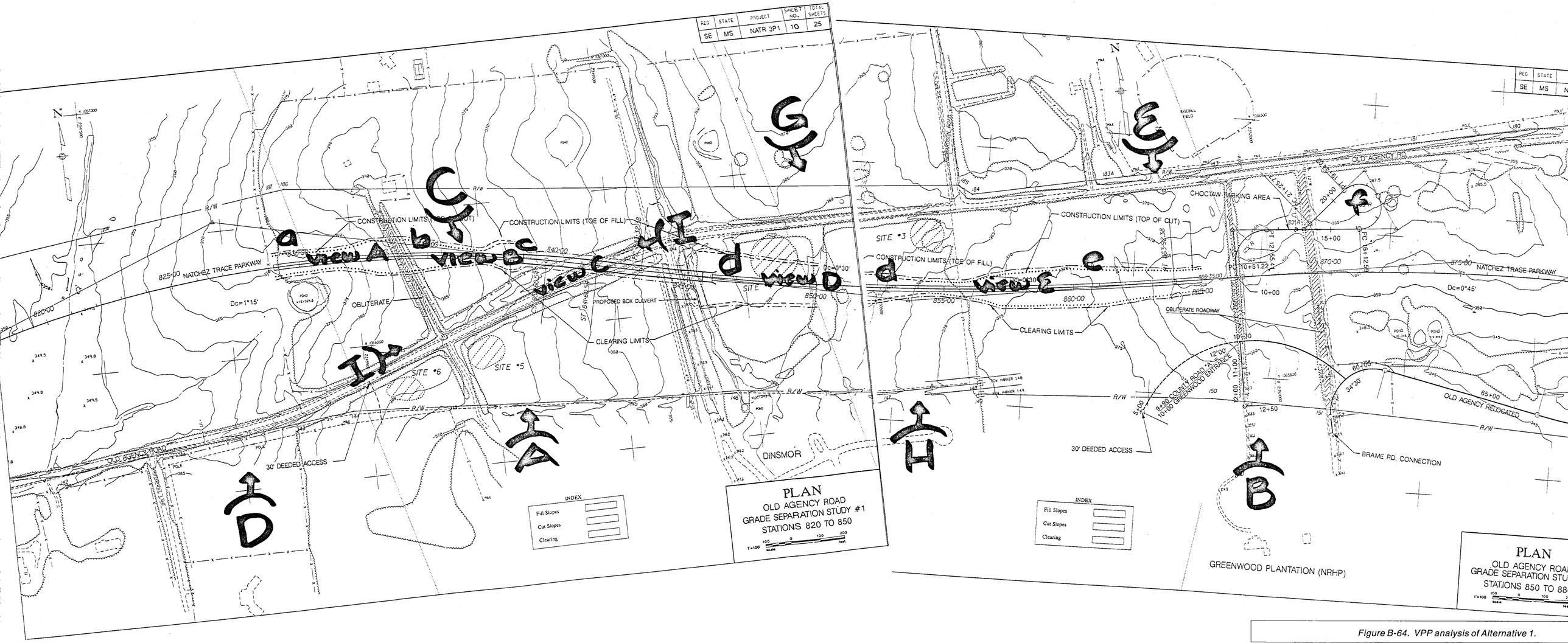
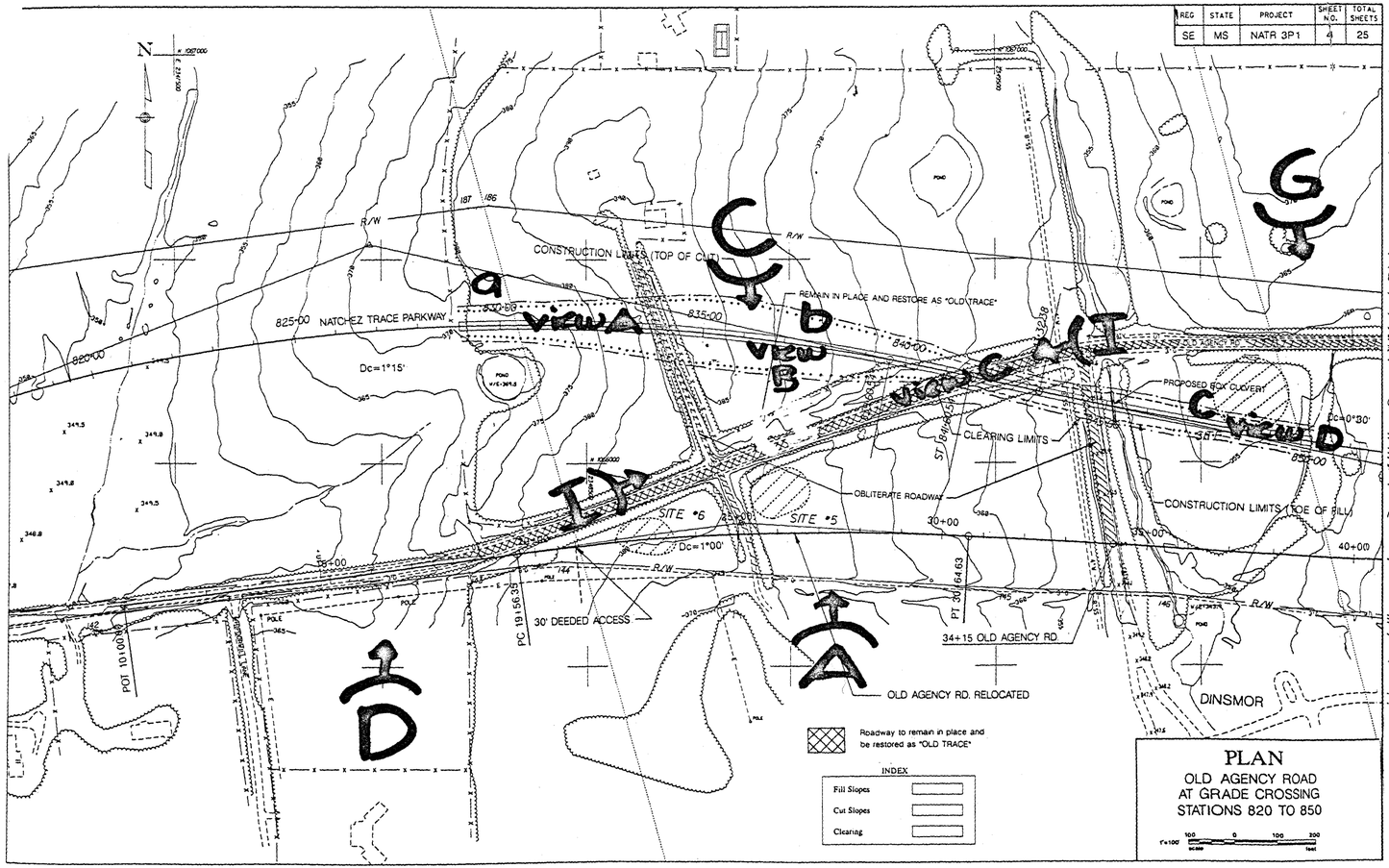
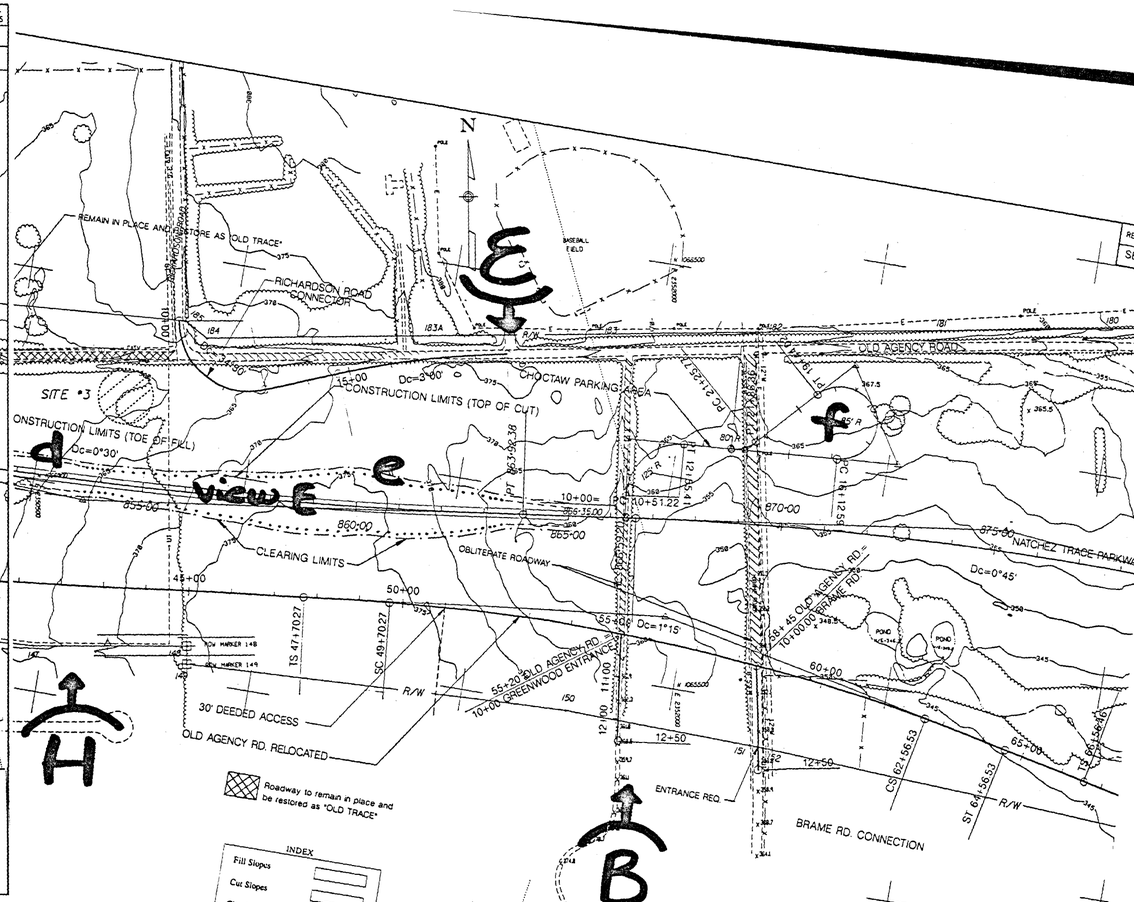


Figure B-64. VPP analysis of Alternative 1.



REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
SE	MS	NATR 3P1	4	25



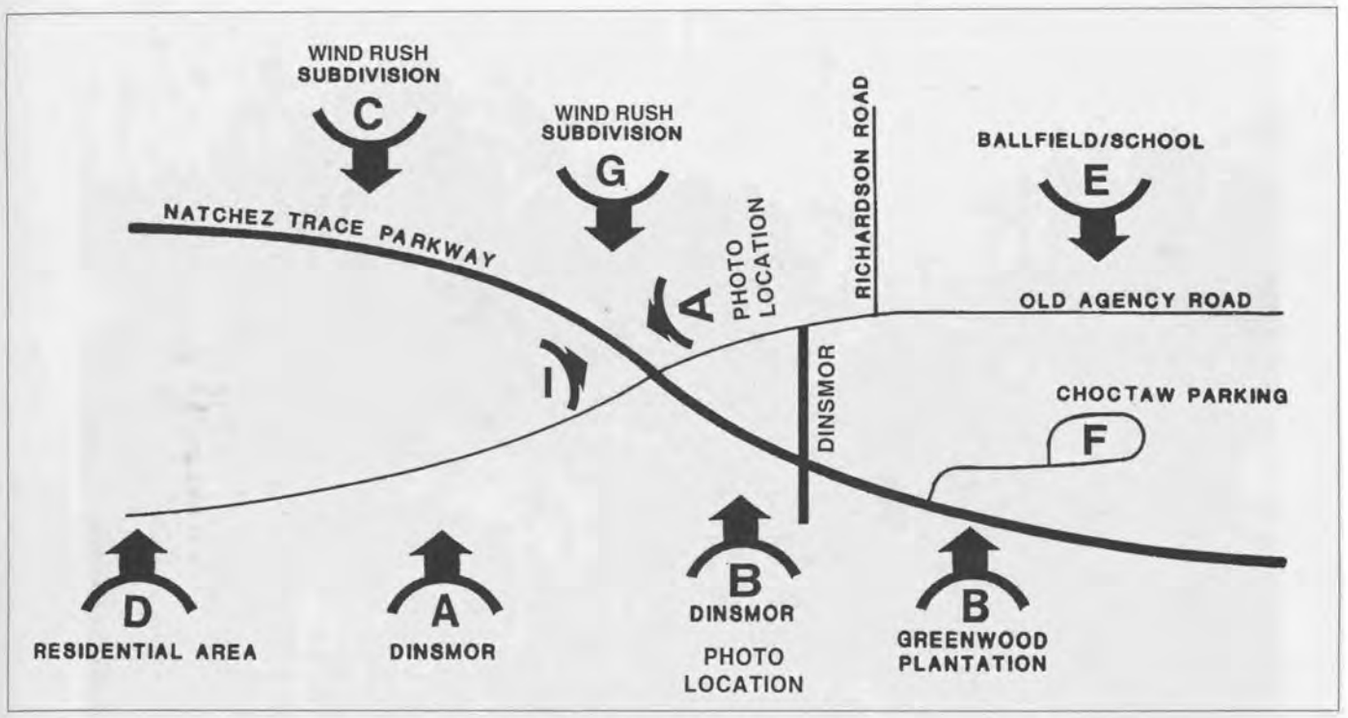


Figure B-66. Map showing site and locations.

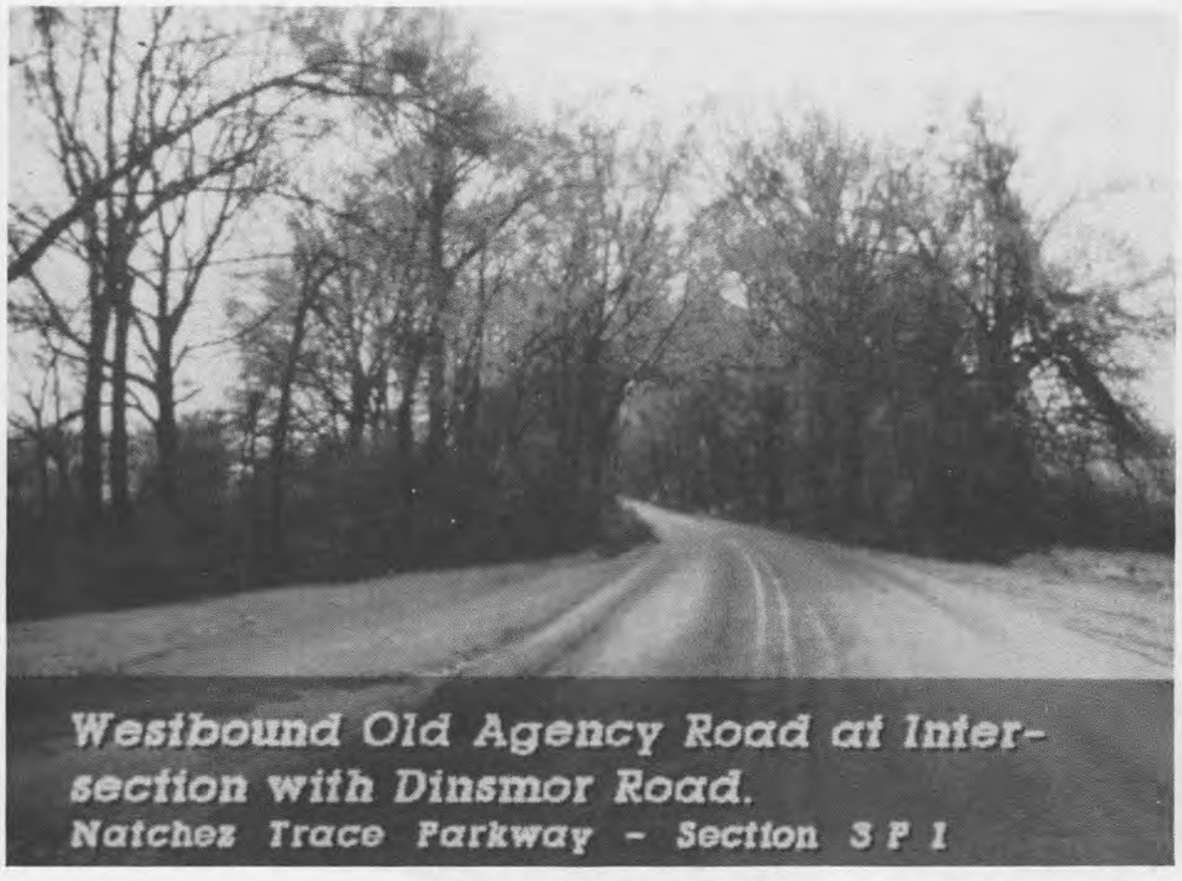


Figure B-67. Existing site from location A.

Figure B-68. Alternative 1—At-grade from location A.

Figure B-69. Alternative 2—Bridge from location A.

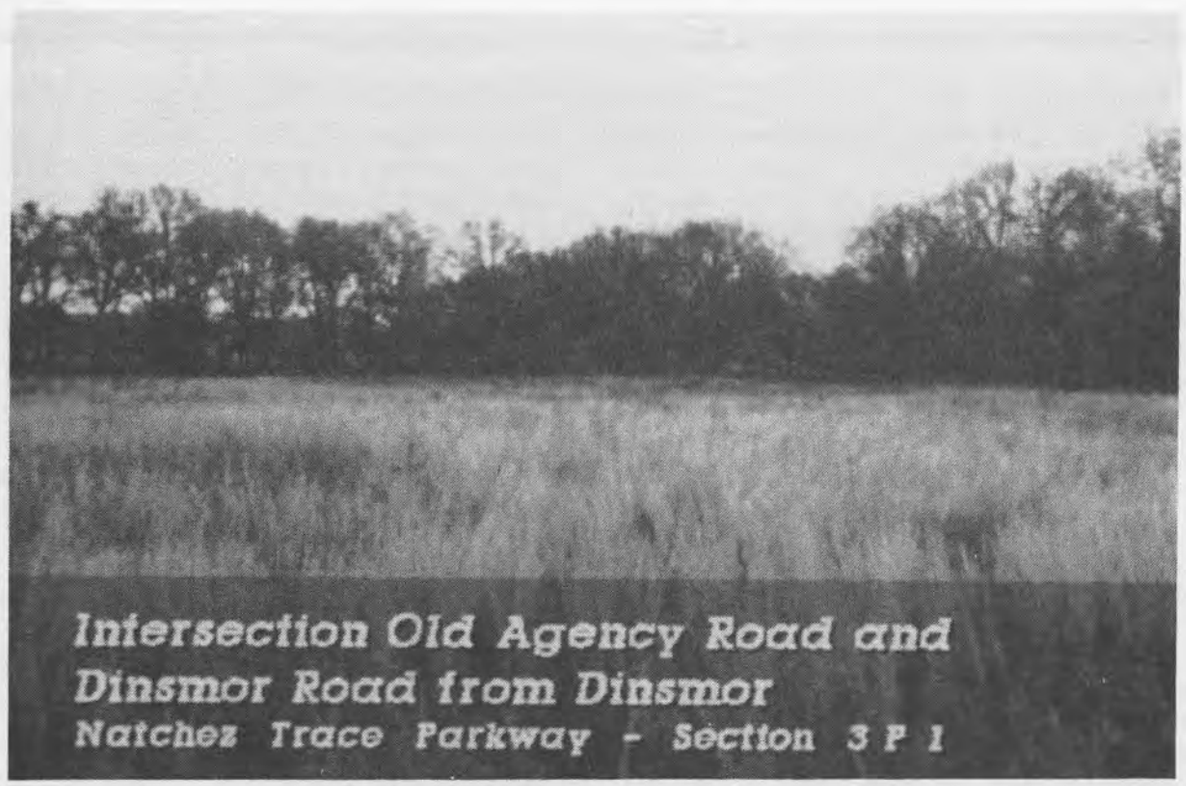


Figure B-70. Existing site from location B.

Figure B-71. Alternative 1—At-grade from location B.

Figure B-72. Alternative 2—Bridge from location B.

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APPENDIX D—CHOOSING BY ADVANTAGES

Choosing by Advantages (CBA) A Decision-Making System

Those who recommend *Choosing By Advantages (CBA)*, and those who mention that they use it, are sometimes asked, "What is Choosing By Advantages? Where did it come from?" The following responds to these questions.

What is CBA?

There are many ways to describe *Choosing By Advantages.* Some say it is a **method** of decision making. Most decision makers and facilitators describe it as a **system** of decision making. Some describe it as a "whole technology ", or "a way of life."

The CBA system includes principles, definitions and models—in addition to methods. It includes a wide variety of methods, with different methods for different types of decisions. The CBA system is for individuals, groups, organizations, and communities. It is for everyone who participates in the decision-making process. Virtually all decisions—from the simplest to the most complex—call for the use of CBA methods.

The CBA process includes both mentally choosing (deciding) and physically choosing (doing). Because it includes both deciding and doing, it is called *Choosing By Advantages*, rather than Deciding By Advantages. For this same reason, some call it a management system.

In CBA, the Art of Decision Making includes three areas: sound decision making, congruent decision making, and effective decision making. The following definitions illustrate these three areas:

Sound Decision Making
Doing the right things. (This is where CBA training begins).

Congruent Decision Making
Doing the right things right—the first time, every time, and on time.

Effective Decision Making
Doing the right things right—the first time, every time, and on time—in a manner that is acceptable to various stakeholders who may have conflicting values and preferences.

Where Did CBA Come From?

The evolution of decision-making methodology, from primitive decision making to *Choosing By Advantages*, can be divided into the following time periods, or eras:

- Primitive Decision Making
- The Frontier Era
- The Proposal-Evaluation Era
- The Impact-Evaluation Era
- Choosing By Advantages

Each era produced a variety of methods, and these methods are still being used today. Valid principles and sound methods from each era are included in the CBA system. Many unsound methods were also produced, and they are excluded.

Primitive Decision Making

Decision making is a natural process. But there are many variations of the natural process. Commonly, in response to thoughts, feelings, observations, or whatever triggers the need for a decision, people naturally, automatically:

1. Make assumptions to fill in data gaps, and
2. Jump to a conclusion.

In the primitive era, assumptions were based on traditions and superstitions, in addition to past experience and present imagination. This method might have been adequate for a complex, rapidly-changing, modern society. The emergence of science moved decision making methodology into the frontier era.

The Frontier Era

In this era, the natural process was continued, but it was improved. In the natural process, people often combine a small amount of data from outside their minds. Then, they treat the combination as if it all comes from outside. The frontier era improved what was inside, as well as outside. Many old superstitions were replace by new scientific findings. However, frontier methods did not always produce better decisions, and they did not make the process visible.

People wanted to participate in the decision-making process. And when they recognized that government officials were using primitive and frontier methods for major decisions, they said: "Wait. Before you decide how to spend our taxes, we want you to **propose** and **evaluate** all major projects and programs, and we want to see the rationale for each decision." This moved decision-making methodology into the proposal-evaluation era.

The Proposal-Evaluation Era

Proposal-evaluation methods were very limited. For example, one method of evaluating proposals simply

weighed the market-valued benefits of the proposal against the direct costs. These methods produced conflict—not effective participation. Those who were proponents of the proposal lined up on one side, those who were opponents lined up on the other side, and they shouted at each other. To make matters worse, proposal-evaluation methods did not evaluate alternatives. People said: "Before you decide, we want to see all the social, economic, and environmental impacts—both positive and negative—of all the relevant alternatives. This moved decision-making methodology into the impact-evaluation era.

The Impact-Evaluation Era

During the impact-evaluation era, the decision-making process, and many of the resulting documents, were horribly complex. Some environmental impact statements were hundreds of pages long and incomprehensible. Methods were developed that did not qualify as sound methods. One that is widely used today is called Weighting-Rating-and-Calculating. The central activities of this method are:

1. Assign numerical **WEIGHTS** to the factors that are important in the decision. (Research has shown, conclusively, that this is a critical mistake.)

2. Display the attributes of the alternatives, and **RATE** each alternative in each factor. (Rating alternatives, or their attributes, is also a critical mistake.)

3. For each alternative in each factor, multiply the weight of the factor times the rating of the alternative to **CALCULATE** an individual score. (This activity multiplies mistakes times mistakes.)

4. Choose the alternative with the greatest total score.

The need to correct these and other mistakes, coupled with the need to simplify, clarify, and unify the decision-making process, is moving decision-making methodology into the era of *Choosing By Advantages*.

Choosing By Advantages

The development of the CBA system required several decades of designing, testing, and improving—building on the best of what had developed before. Many individuals and groups—mostly in the USDA Forest Service—participated in this development process. The result is a decision-making system that answers four vital questions:

1. How can we make sound decisions?

2. How can we simplify sound decision making?

3. How can we clearly show that our decisions are sound?

4. How can we make our decisions congruent and effective?

The CBA methods have been used successfully for a wide variety of decisions—from very simple to very complex. The results of these applications, and many careful examinations of the logic of the CBA process, have shown that the CBA system is sound, clear, simple, and effective.

Some CBA methods, but not all, are natural methods. All CBA methods base decisions, either implicitly or explicitly, on the importance of advantages—where an advantage is defined as a favorable difference between the attributes, or characteristics, of two alternatives. All disadvantages (unfavorable differences) are included by transforming them into advantages. Consider the following disadvantages, for example: "Route B is three miles longer than A." This becomes, "Route A is three miles shorter than B."

Only those methods that base decisions implicitly on the importance of advantages are natural methods. Basing decisions explicitly on the importance of advantages is a skill that has to be taught. In this regard, CBA is like reading, writing, mathematics, and other skills required in a modern society. Therefore, education is key to successful use of the CBA system. CBA workshops are available from:

The Institute for Decision Innovations
2877 North 1050 East
Ogden, Utah 84414
Telephone: (801) 782-6168

The following page is an outline of a three-day sound decision-making workshop. Similar workshops are available for congruent decision making and effective decision making.

(OUTLINE OF A 3-DAY SOUND DECISION-MAKING WORKSHOP)

INTRODUCTION: WHAT IS CBA?

PART I. SOUND DECISION MAKING: NON-MONEY DECISIONS

1. DECISIONS MUST BE ANCHORED TO THE RELEVANT FACTS
   - The Bridge-Design Experiment
   - Critical-thinking Skill for Sound Decision Making
2. DECISIONS MUST BE BASED ON THE IMPORTANCE OF ADVANTAGES
   - Key Definitions
   - Comparison Displays
   - The Two-List Method
3. DECISIONS AND DECISION METHODS DO MATTER
4. DIFFERENT DECISIONS REQUIRE DIFFERENT METHODS
5. SIMPLIFY COMPLEX DECISIONS BY TAKING FEWER STEPS
   - The Tabular Method
   - Special Methods for Complex and Very Complex Decisions
6. SIMPLIFY SIMPLE DECISIONS BY TAKING FEWER STEPS
   - The Simplified Tabular Method
   - TheSimplified Two-List Method
   - Instant CBA
   - Very Simple Methods for Very Simple Decisions
7. SIMPLIFY ALL DECISIONS BY CORRECTLY USING CORRECT DATA
   - The Sound Decision-Making Model
   - Preference Curves and Preference Charts

PART II. SOUND DECISION MAKING: MONEY DECISIONS

8. MONEY DECISIONS REQUIRE SPECIAL METHODS
9. DIFFERENT CONTEXTS REQUIRE DIFFERENT METHODS
   - Context One
   - Context Two
   - Context Three
   - Context Four
   - Allocation Decision Making

PART III. THE ART Of DECISION MAKING

THE CBA MODEL OF THE ART OF DECISION MAKING
IMPLEMENTATION AND OPERATION OF THE CBA SYSTEM

CONCLUSION: HOW TO BECOME AN ARTIST IN THE ART OF DECISIONMAKING

APPENDIX E—PERFORMANCE INDEXING

Process Map makes use of a performance indexing scheme similar to the Objectives Matrix developed at the University of Oregon. Conceptually, here's how it works in basic steps:

1. Select the measures.

2. Enter the available data for the first measure.

3 Specify a goal somewhat above what has been achieved to date.

4. Specify a minimum level of achievement, below which no performance level is acceptable.

5. Convert goal and minimum performance level numbers into a 10 point scale, (where the total is a 10 and the minimum is a 0) thus creating an indexed scale.

6. Repeat steps 2 through 5 for the other measures.

7. Assign weights to the measures, with higher weights assigned to those measures which are relatively more important.

8. As new measurement data becomes available, Process Map will automatically calculate each new data point number on its particular indexed scale, multiply it by the weight assigned to its particular measure, and add these totals to create a time-trended overall performance index. Now, performance trends can be viewed overall and different measures can be compared with each other on a common scale.

The benefits of performance indexing are significant. By forcing goals to be set, measurements can proceed in a context of improvement as opposed to measurement for its own sake. By assigned relative weights to the goals, the performance mission becomes very sharply defined; what's important becomes clear and relative priorities have been set. By focusing on time trends instead of single data points, an orientation towards continuous improvement is fostered. By developing the performance index in a participative fashion, multiple ideas can be welded together, understanding of good measurement promoted, and commitment developed.

By using the performance index graphically on a regular basis, progress reviews and update meetings can take on more of a problem-solving orientation as opposed to an "explain what the numbers mean" session. And by automating the calculations required for indexing, measurement becomes a useful tool instead of a laborious number-crunching exercise.

APPENDIX F—LIST OF ABBREVIATIONS

B — Background

BLM — Bureau of Land Management

CBA — Choosing By Advantages

CTIP — Coordinated Federal Lands Highway Technology Implementation Program

EA — Environmental Analysis

EIS — Environmental Impact Statement

F — Foreground

FHWA — Federal Highway Administration

I — Intermediate Foreground

M — Middleground

NPS — National Park Service

NVC — Net Visual Change

SCS — Soil Conservation Service

SMS — Scenery Management System

TVC — Total Visual Change

VMS — Visual Management System

VPL — Visual Priority Level

VPP — Visual Prioritization Process

VRM — Visual Resource Management

APPENDIX G—GLOSSARY

Angle of View—the horizontal and/or vertical angle between the observer's direct line of sight and the line of sight to view the element, ranging from direct to peripheral.

Aspect—the orientation of the element to the observer, ranging from facing direct to facing away.

Background—distance zone farthest from the observer, normally more than 5mi (8.1 km).

Character—the distinctive natural, cultural, social, and historical resources of a geographical area including the "feeling" of the area.

Character Zones—sections with similar visual resources within an area.

Characteristic Landscape—visual resources typical for the character zone.

Distance Zones—areas within a specified distance of the observer, normally described as Immediate Foreground, Foreground, Middleground, and Background. It is based on variables such as speed, aspect and angle of view.

Duration of View—the amount of time the observer can view the elements and is based on speed, aspect and angle of view.

Elements—visual resources that are natural, cultural, social or historical, such as vegetation, walls, rock formations, utility poles, historical buildings, etc.

Foreground—distance zone near the observer, normally 300-700 ft (91.4-213.4 m).

Magnitude—the size or scale of the element.

Middleground—distance zone between foreground and background, normally 700 ft-5 mi (213.4 m-8.1 km).

Mitigation—the size or scale of the element.

Net Visual Change—a measure of the predicted difference in visual resources resulting from a proposed project. The total score of all the negative visual resources subtracted from the total score of all the positive visual resources within unit.

Numerical Score—numbers which stand for the value of a variable tabulated on the inventory forms and typically are 1, 2, and 3.

Retention—a Forest Service Visual Objective intended to keep construction unnoticeable to observers upon completion of the project.

Significant—being important enough for mitigation based on visual management objectives, environmental laws and viewer opinion.

Silhouette—background of element either vegetation, sky, or no background based on angle of view.

Proposed Visual Element/Resource—elements that will be new to the area due to construction, such as, cuts, fills, bridges, retaining walls, view areas.

Total VisualChange—the total numerical score when the total score of all the negative visual resources are added to the total score of all the positive visual resources. This total is for the visual unit and is based on changes that the project will cause.

Variables—six items used to determine relative importance of elements to the visual goals of the area. The six items are: distance from viewer, magnitude, angle of view, duration of view, silhouette and aspect.

Values—definition of the three portions of each variable for each numerical score, such as the value of 0-600 sq ft (55.7 sq m) for the variable-Magnitude. The range will vary with each project.

View Points—specific location of observer when viewing elements for determination of values for variables, such as, distance from viewer, duration of view, silhouette, angle of view and aspect.

View Sheds—the total view of an element or area from all the potential observer locations.

Viewing Public—any observers of the elements including drivers, hikers, picnickers, campers, property owners, workers.

Visual Units—sections within a land management area that have similar visual resources.

Visual Priority Level—the relative importance of the element/unit compared to the other units. This is based on the various subtotals, such as, the elements total score, units total score, the net visual change, the total visual change. There are normally three levels with the highest scores being in priority level 1 (most relative importance) to the lowest scores being in level 3 (least relative importance).

UNIT VPP INVENTORY-NEW VISUAL ELEMENTS

UNIT NO._____

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
CUTS																										
FILLS																										
WALLS, RAILING, GUARDRAIL																										
BRIDGES																										
STRUCTURES																										
UNIT TOTAL																										

(NEGATIVE, POSITIVE, OR NEUTRAL?)

UNIT VPP INVENTORY-LOSS OF SIGNIFICANT VISUAL RESOURCES

UNIT NO._____

STATION	MAGNITUDE				ANGLE: HORIZONTAL				ANGLE: VERTICAL				DURATION/ VISIBILITY				SILHOUETTE				ASPECT				SUB TOTAL	TOTAL/ ELEMENT
	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B	I	F	M	B		
VEGETATION																										
WALLS																										
STRUCTURES																										
ENCLOSED VIEW																										
OPEN VIEW																										
																									UNIT TOTAL	

(NEGATIVE, POSITIVE, OR NEUTRAL)

PP INVENTORY - NEW VISUAL ELEMENTS

UNIT NO.

STATION:	ELEMENT NUMBER		MAGNITUDE		ANGLE HORIZONTAL		ANGLE VERTICAL		DURATION/ VISIBILITY		SILHOUETTE		ASPECT		SUB	TOTAL/
			Sq. Feet	Score	Angle	Score	Height	Score	Seconds	Score	Description	Score	Aspect	Score	TOTAL	ELEMENT
2202 - 2215	1E	I	86,401	3	9	3	66.5	2	8	3					11	21
comments: CUT - 1300' total length		F	86,401	3	9	3	66.5	2	7	2					10	
		M		0		0		0		0					0	
		B		0		0		0		0					0	
2202 - 2215	1W	I	85,348	3	9	3	66	2	8	3					11	18
comments: CUT		F	85,348	3	22	1	66	2	3	1					7	
		M		0		0		0		0					0	
		B		0		0		0		0					0	
2215 - 2225	2E	I	53,676	3	11	2	54	2	7	3					10	18
comments: CUT - 1000' total length		F	53,676	3	16	2	54	2	6	1					8	
		M		0		0		0		0					0	
		B		0		0		0		0					0	
2215 - 2225	2W	I	44,739	2	3	3	45	2	7	3					10	27
comments: CUT		F	44,739	2	5	3	45	2	12	2					9	
CUT		M	44,739	2	5	3	45	2	5	1					8	
		B		0		0		0		0					0	
2225 - 2236	3E	I	67,667	3	0	0	0	0	0	0					3	6
comments: FILL - 1100' total length		F	67,667	3	0	0	0	0	0	0					3	
		M		0		0		0		0					0	
		B		0		0		0		0					0	
2225 - 2236	3W	I	62,420	3	0	0	0	0	0	0					3	10
comments: FILL		F	62,420	3	0	0	0	0	0	0					3	
		M		0		0		0		0					0	
		B		0	15	2		0	8	2					4	